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Author(s): Hamid Omrani Rekavandi, Eberhard W. Sauer, Tony Wilkinson, Esmail Safari Tamak, Roger Ainslie, Majid Mahmoudi, Seren Griffiths, Mohammad Ershadi, Julian Jansen Van Rensburg, Morteza Fattahi, James Ratcliffe, Jebrael Nokandeh, Amin Nazifi, Richard Thomas, Rowena Gale and Birgitta Hoffmann

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AN IMPERIAL FRONTIER OF THE SASANIAN EMPIRE: FURTHER FIELDWORK AT THE GREAT WALL OF GORGAN

By Hamid Omrani Rekavandi (HO), Eberhard W. Sauer (EWS), Tony Wilkinson (TW), Esmail Safari Tamak (EST), Roger Ainslie (RA), Majid Mahmoudi (MM), Seren Griffiths (SG), Mohammad Ershadi (ME), Julian Jansen Van Rensburg (JJ), Morteza Fattahi (MF), James Ratcliffe (JR), Jebrael Nokandeh (JN), Amin Nazifi (AN), Richard Thomas (RT), Rowena Gale (RG) and Birgitta Hoffmann (BH)

Abstract

The 2006 season has yielded significant new insights into the Great Wall of Gorgan's relation to landscape features and settlement, notably the division of the associated complex water supply system into sectors. The westernmost part of the wall is buried deeply beneath sediments from a past transgression of the Caspian Sea. An unexpectedly high number of brick kilns, of standardised design, shed light on the manner of the wall's construction. Geophysical survey, satellite images and excavations have established that some or all of the associated forts were densely occupied with buildings, thought to be barracks, suggesting a strong military garrison.

Keywords

Forts; landscape Archaeology; linear barriers; Sasanians; water supply.

I. INTRODUCTION (HO, EWS, TW & EST)

The second season of the joint project, between the Iranian Cultural Heritage and Tourism Organisation (ICHTO) and the Universities of Edinburgh and Durham, to explore the linear barriers of northern Iran, near modern Gorgan and Gonbad-e Kavus, took place in September 2006. Our aims included obtaining further dating evidence for the construction of the Great Wall of Gorgan and the duration of occupation of the associated forts. We equally hoped to gain further insights into the extent, purpose and design of the associated water supply system, the organisation of brick production for the wall, as well as the location of the wall's terminals in the west and east. The 2005 season had yielded little tangible evidence for the nature of the occupation of the forts, and the size of their garrisons and substantial further progress here in 2006 was a major desideratum. Unlike 2005, all our efforts in the short 2006 season were concentrated on the Great Wall of Gorgan and we carried out no further work on the Wall of Tammishe.

II. THE GORGAN WALL IN ITS LANDSCAPE (TW & HO)

One of the more significant results of the 2005 field season was that a system of water supply had been incorporated into aspects of the wall design and construction. Consequently, one of the main aims of the 2006 field work by T.J. Wilkinson and H. Omrani Rekavandi was to find out more about related hydraulic installations as well as to understand how the Gorgan Wall related to both the natural and cultural landscapes of the region. These studies, which elaborate on the considerable amount of earlier work by Jebrael Nokandeh and Hamid Omrani Rekavandi, covered most of the length of the wall from near Fort 2 in the east, to beyond Fort 33 near the Caspian Sea in the west.

III. WATER SUPPLY (TW & HO)

The 2005 field season had recorded three major canals that led water from the Gorgan River, and in 2006 two

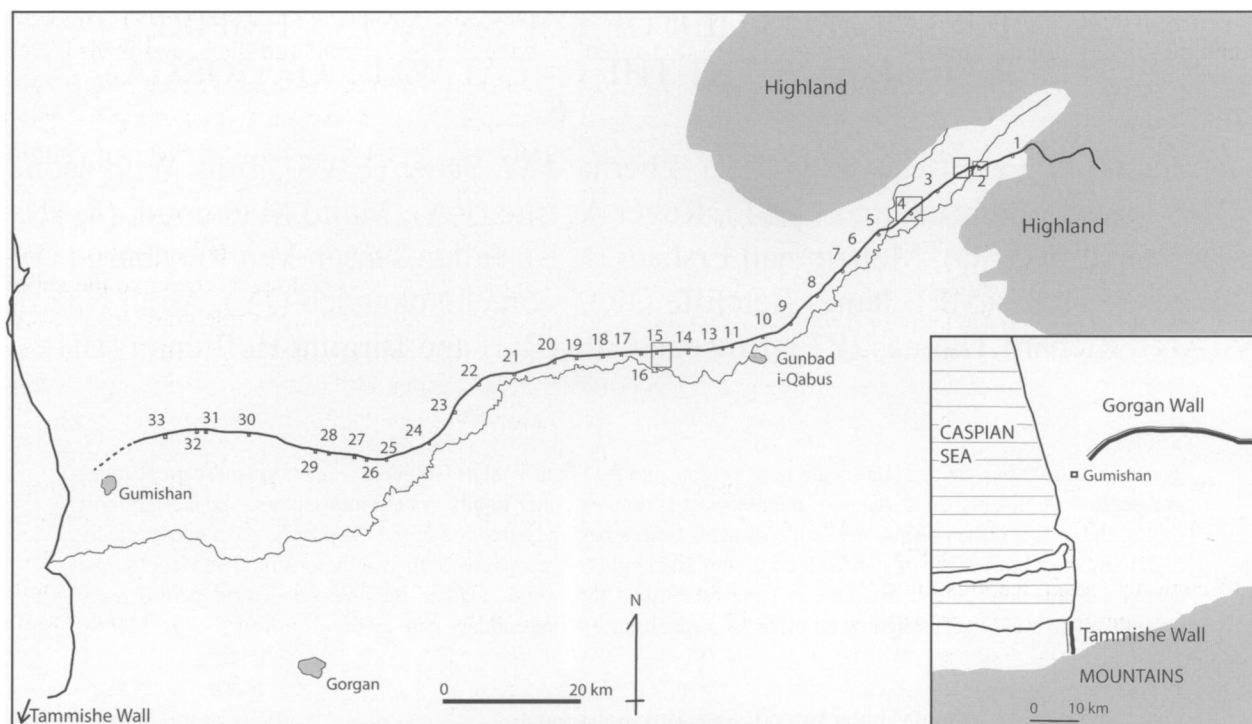


Fig. 1. The Gorgan Wall. Suggested sectors of the wall are as follows: east, from Fort 1–2; east central, from Fort 2–4; main, from Fort 5 west. The Digje canal is between Forts 16 and 17, and a possible canal is located by Fort 4.

more were noted, to make a total of five cross (or feeder) canals which apparently conducted water from the Gorgan River to the ditch on the north side of the Gorgan Wall (Fig. 1). The western-most feeder canal was recorded during the 2006 field season (having been

previously discovered by Hamid Omrani and his team). This feature, referred to as the Digje canal, was confirmed and mapped between Forts 16 and 17. This c. 12 m. wide canal forms a well-defined channel that led water from what is now a relict arm of the Gorgan



Fig. 2. Area of embanking along the wall (the alignment parallel to the top border) with Fort 15, the rectangular enclosure near the left margin, abutting the wall. Four parallel stripes are visible in the interior, at right angles to the wall. CORONA image by courtesy of US Geological Survey, with permission.

River, which has shifted its course about 1 km. to the south, to the Gorgan Wall ditch to the north. There was no evidence of an earthen dam associated with this canal, presumably because, like most of the others, it had been removed by the dynamic and erosive Gorgan River.

Less certain is a channel-like feature immediately west of Fort 4 (Figs 11, 24). This feature joins the well-defined ditch west of Fort 4, and appears to have gathered its water from the Gorgan River *c.* 1.5 km. to the south. Unfortunately, the junction of this putative feeder canal with the river has been expunged by a massive gully system which has subsequently eroded back along the canal course south of Fort 4.

Other possible feeder canals were observed immediately east of Fort 14 and east of Fort 18. Unfortunately, neither was sufficiently clear, nor had sufficient diagnostic features to be classified as a canal.

In the central part of the wall, immediately to the west of Fort 15, the line of the wall was taken by a broad silt bank which became relatively higher to the west, apparently as the wall entered a broad, very shallow south to north flowing valley (Fig. 2). Thus at 37°15.657' north and 55°02.292' east to the east, the bank was only 16 m. wide and 1–1.5 m. in height, whereas at 37°15.652' north and 55°01.590' east, 1 km. further west (a short distance from Fort 15), it had risen to some 3.00 m. high and 36 m. wide. The presence of occasional bivalves on the surface suggests the bank

may have been associated with flowing water. This bank follows the line of the wall and ditch, and is visible on Corona images as a broad pale soil feature (Fig. 2), and on the map of Kiani as a faint feature along the south side of the wall (Kiani 1982: fig. 3). It therefore appears that to the east of Fort 15, the wall gives way to a silt bank that maintains the gradient of the terrain from east to west where a shallow valley would otherwise have required the wall to have followed down into the valley and up the other side. Although these gradients are very subtle, this highlights how the Gorgan Wall differs from many other frontier walls: it does not follow the rises and falls of the terrain, but rather, in the manner of a canal, it attempts to maintain a very gentle gradient (*i.e.* a hydraulic grade), in this case from east to west. Although the actual presence of a ditch or canal is difficult to recognise along this stretch of wall (and indeed requires further investigation), a hydraulic function to the wall/bank is supported by the presence of the freshwater bivalves on the surface.

Of the three well-defined feeder canals recorded in 2005, the central Aghabad canal (between Forts 8 and 9), was sampled by Morteza Fattahi for OSL dating.¹ This section, which was cut back and cleaned through the eastern bank of the canal (Figs 3–4), clearly demonstrated that during the original excavation of the canal considerable quantities of pale brown silt loam had been cast up over the original land surface. This buried soil, a slightly reddish brown loam with well developed calcium

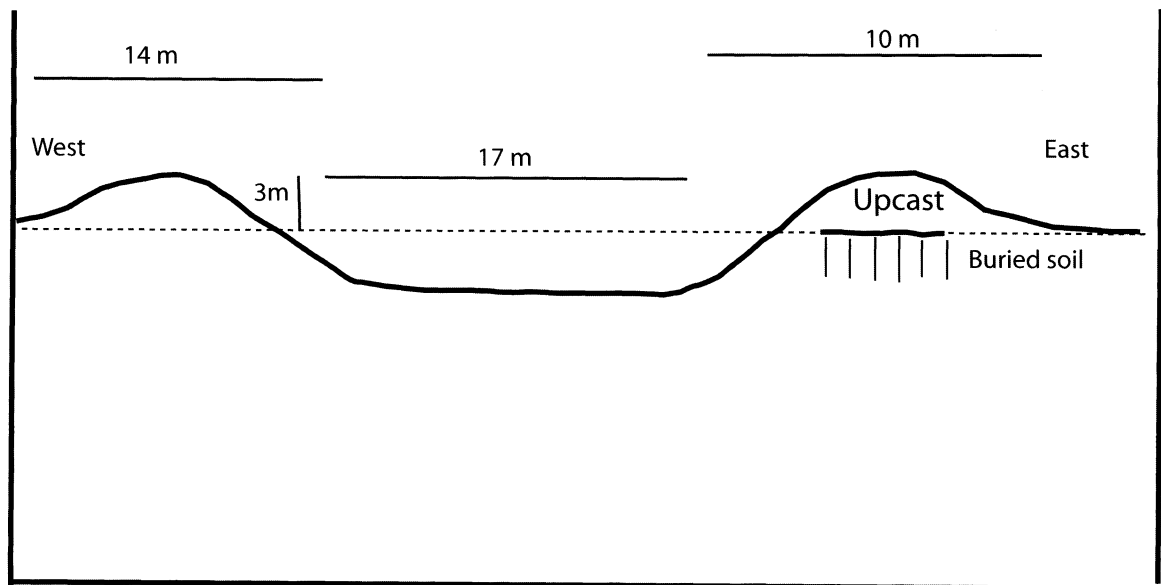


Fig. 3. Sketch section across Aghabad canal showing buried soil and upcast bank deposits.

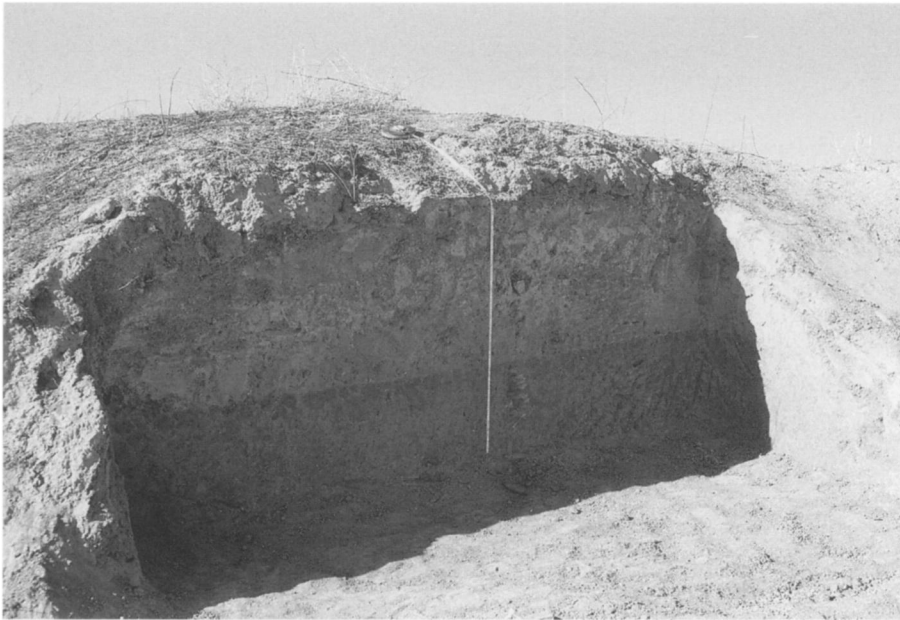


Fig. 4. Aghabad canal: the bank deposits overlying buried soil.

carbonate concretions, represents the ancient soil that developed on the loess plain over many millennia. The presence of a clear bank of upcast silt over a pre-existing soil surface demonstrates that the feature was indeed a canal, although it is not clear whether the silts were from the original excavation of the canal, from subsequent cleanings or a combination of the two.

Despite the presence of the magnificent Garkaz dam, the Sadd-i Garkaz (Nokandeh *et al.* 2006: 140–41), no other dams were found in association with the cross canals. The probable association between the Chai Ghushan Kuchek canal and Garkaz dam was confirmed by high-resolution satellite imagery (Corona) which clearly demonstrates how the dam is on precisely the same orientation as the canal, which received water from the dam. On the other hand to the west near Fort 9, the Sarli Makhtoom canal was associated with a complex series of possible inlet channels in the vicinity of the Gorgan River, but there was no evidence of a dam. The lack of dams in association with the feeder canals is probably a result of the very dynamic and erosive regime of the Gorgan River, which has removed all traces of them, an interpretation that requires testing by the use of satellite imagery and (if available) aerial photography.

Although a compelling case can be made for the presence of a canal system associated with the Gorgan Wall, it is not yet clear whether such systems were simply for the supply of water for the manufacture of baked bricks, or were also for the irrigation of fields.

Nevertheless, it does appear that there were substantial irrigation systems in existence before the Gorgan Wall was built. This is particularly evident immediately adjacent to Fort 23 where a linear feature originally mapped by Kiani (1982: map 6) was demonstrated to be a large linear bank of spoil from a major canal. The up-cast deposits that resulted from the initial excavation of the canal (now filled with sediment) as well as its subsequent cleaning out were clearly recognisable in a recently cut section through the bank. Significantly, Kiani's map 6 indicates that this feature had been cut by the Gorgan Wall thereby demonstrating that the canal existed prior to the construction of the wall. This is supported by the observation (by Hamid Omrani) that a large site along the line of this canal spoil bank is of Parthian or Sasanian date. It would therefore have been necessary for the Sasanian builders of the Gorgan Wall to take such pre-existing features into consideration during the construction of the wall. Interestingly, this type of canal is different in its conception from the feeder canals of the Gorgan Wall, because the heavy silt load evident from the clods of silt/clay found in the bank deposits is entirely different from the deposits of the upcast mounds of, for example the Aghabad canal (discussed above). It has already been suggested that the latter feeder canals were dug but never cleaned out, presumably because they derived their water from the upper layers of reservoirs that were empounded behind cross-river dams (Nokandeh *et al.* 2006: 141).



Fig. 5. The Great Wall of Gorgan, marked by a scatter of fragments of the typical bricks, follows the grass-covered ridge in the foreground, overlooking a deep valley to the left, and extends to the vicinity of the vertical rock face in the Elburz Mountains in the background (or possibly beyond).

IV. THE GORGAN WALL'S WESTERN AND EASTERN TERMINALS (HO, EWS, JR & SG)

The location of the terminals of the Great Wall of Gorgan has been the subject of much debate. We know that the Wall of Tammishe runs from the Elburz Mountains to the coastal plain of the Caspian Sea, where the wall extended to below the present Caspian level because the Sea was lower at the time of its construction. Similarly, one might assume that the contemporary Great Wall of Gorgan reached the ancient sea shore in the west (and might conceivably even have joined the Wall of Tammishe), as a defensive wall only makes sense, if there was no easy way to bypass it (see below “X. *The Gorgan and Tammishe Walls* pp. 112–3”). At the easternmost end we followed the wall, which is easily recognisable by fragments of robbed bricks extending to 37°29.587' north and 55°45.096' east, to just a few metres from a vertical rock face (Figs 5–6). Further fieldwork is required to test whether it continues on the other side of the rock face into the mountainous landscape of the Golestan National Park, or even, with or without major gaps, much further east as some have suggested (Adle 1992: 195 fig. 2, 204–5).

The westernmost known section of the Gorgan Wall is marked for some distance by a distinct robber trench, stretching up to 4.5 km. west of Fort 33. In order to test whether or not the wall continued and was detectable, we carried out a magnetometer survey (Fig. 7) in direct



Fig. 6. The overhanging rock, marking a possible terminal of the wall (see Fig. 22), would have formed a substantial obstacle.

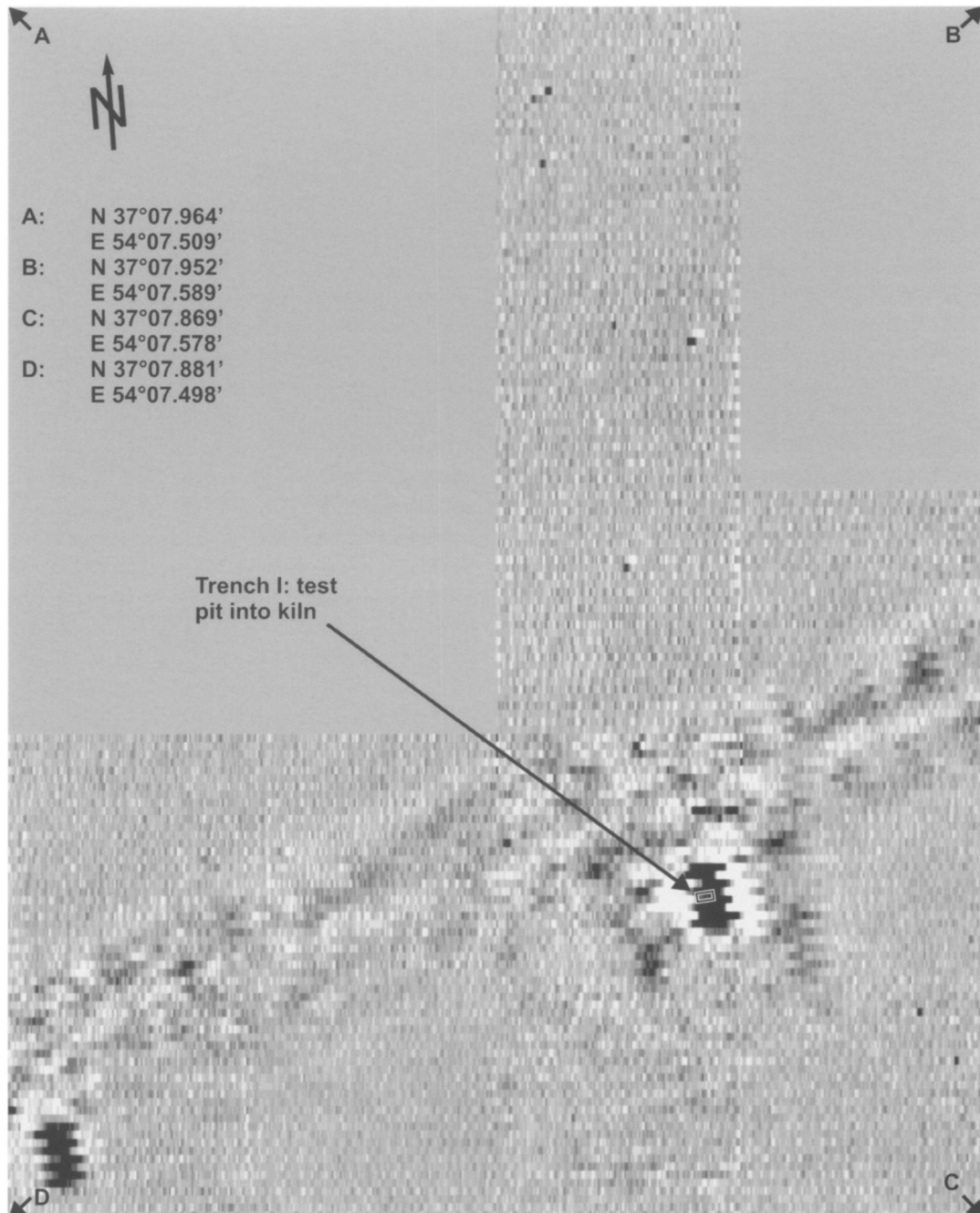
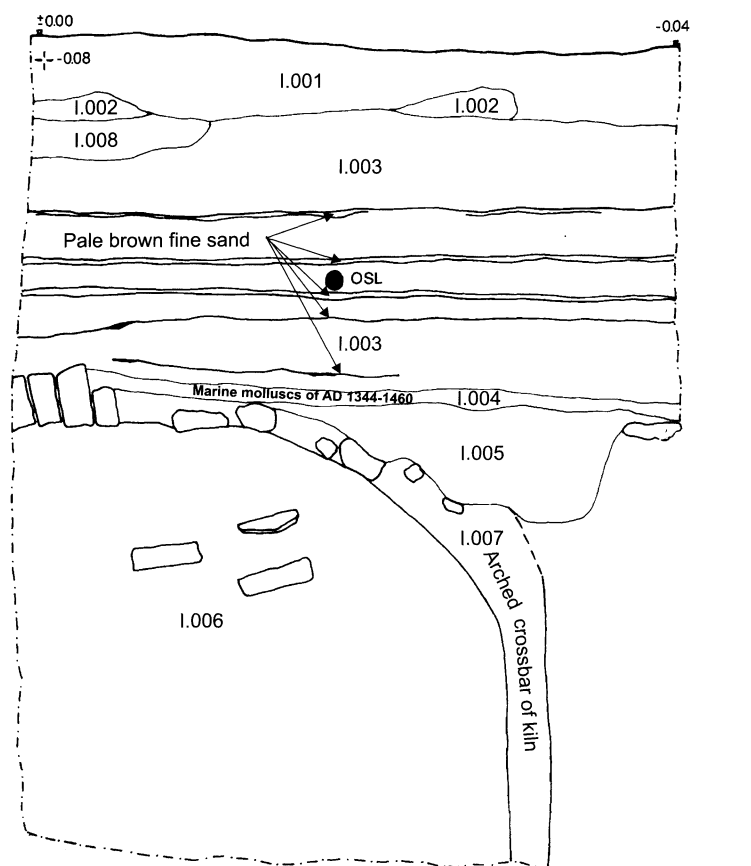


Fig. 7. Magnetometer survey of the Gorgan Wall and two associated kilns, c. 4.8 km. west of Fort 33, with the location of Trench I, by JR, SG and HO. The linear anomaly is likely to represent the Gorgan Wall robber trench and associated ditch, the two rectangular anomalies south of it are two kilns.

continuation of the robber trench some 300 m. west of its visible terminal. The survey revealed a distinct linear anomaly, c. 18 m. wide, likely to have been caused by a combination of scattered brick fragments from the robbed-out wall, any remaining foundations of the wall and, probably, an associated ditch. Behind it, as in the

case of the survey of Fort 30 on the protected south side of the wall, we found two positive anomalies, whose rectangular shape, size and strength suggested two further brick kilns, c. 86 m. apart. The postulated continuation of the ditch could have provided the water necessary for brick making.



Section of brick kiln (Trench I)

The Great Wall of Gorgan Project 2006
 Drawn by M.Hussein Zadeh

Fig. 8. North-facing section of Trench I, drawn by Maryam Hussein-Zadeh.

V. A BRICK KILN FLOODED BY THE CASPIAN SEA (HO, TW, EWS, MM, SG & JR)

In order to test the hypothesis that the eastern anomaly indeed represents a kiln and to explore the reasons why no brick fragments or other traces of the postulated kiln and robber trench were visible on the surface, we excavated a 2×1 m.-large test pit (Trench I) through a very low shell-covered north-south ridge. According to figure 8b of Kiani, the wall may have extended some 2 km. further to the west of Trench I, after which it either terminated or disappeared from view. We encountered the top of the kiln 0.98–1.07 m. below the surface (Fig. 8). Substantial parts of two of the typical arches survived within our trench and a small part of a third (Figs 8–9). A brick *in situ* was selected for OSL dating.

The abandoned kiln was immediately overlain by a layer of marine bivalve shells (deposit I.004), some of

them still found in pairs, suggesting that the soft tissue of these marine molluscs had rotted *in situ*. There is thus no doubt that the kiln was flooded by the Caspian Sea. Subsequently *c.* 1 m. of weakly bedded mottled clay built up, with thin lenses of pale brown fine sand (deposits I.001, I.002, I.003 and I.008) of a type typically deposited either in lagoons, mudflats or a shallow embayment of the sea (Fig. 8). The accumulation of this transgression deposit was followed by an episode of drying and soil formation followed by either a subsequent regression of the sea, a second transgression (represented by a thin accumulation of sands and the marine bivalve *Cardium*: cockle), or a localised episode of aeolian accumulation. The elevation of this part of the wall, *c.* -22 m. in relation to global sea level, is some 6 m. above present Caspian Sea level. According to the studies of the Russian scientist G.I. Rychagov (1997), the most likely event(s) that would

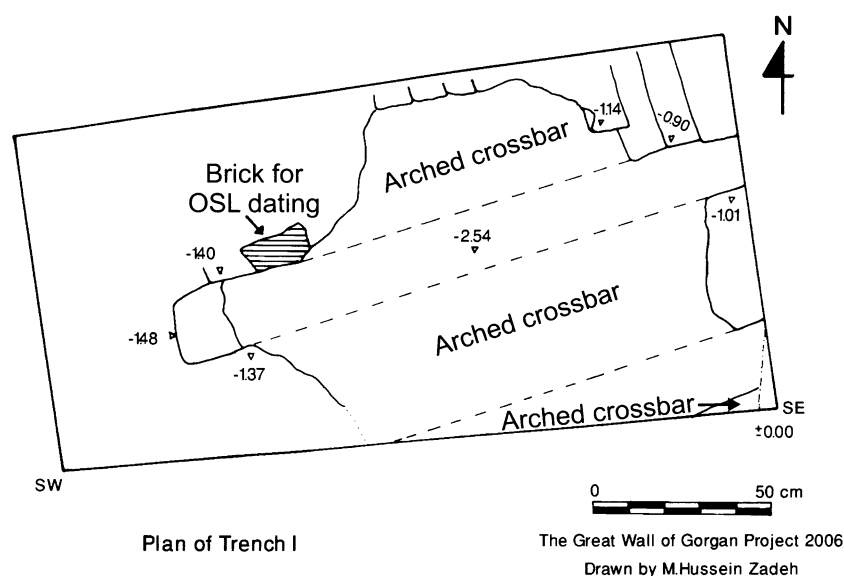


Fig. 9. Plan of Trench I, drawn by Maryam Hussein-Zadeh.

correspond to this inundation were a series of transgressions that reached *c.* -22 m. between *c.* 500 years ago and the present day (Fig. 10). The shells from context I.004 have now yielded a radiocarbon date of A.D. 1344–1460 at 95.4% confidence level² for the initial transgression. Although this high sea stand corresponds chronologically to that of Rychagov, the elevation of the equivalent event along the Gorgan wall, at -22 m., is some 3 m. higher than Rychagov's estimate. Further dates and field studies are therefore required from the Gorgan Wall Project in order to sort out some of these contradictions.

In order to recover additional evidence for the marine transgression at Trench I, the distribution of shells was traced along the line of the Gorgan Wall to the east between Trench I and Fort 33. Here the wall was evident as occasional fired bricks and robber pits, partly obscured by a veneer of shells of the same species as those exposed in Trench I. This shell scatter was traced east of Trench I to within 1 km. west of Fort 33, at which point it faded out at an elevation of *c.* -22 m. (in relation to global sea level). Significantly the shells fade out in the vicinity of a faint north-south feature mapped by Kiani and colleagues (stippled on Kiani 1982: fig. 8b). This feature probably

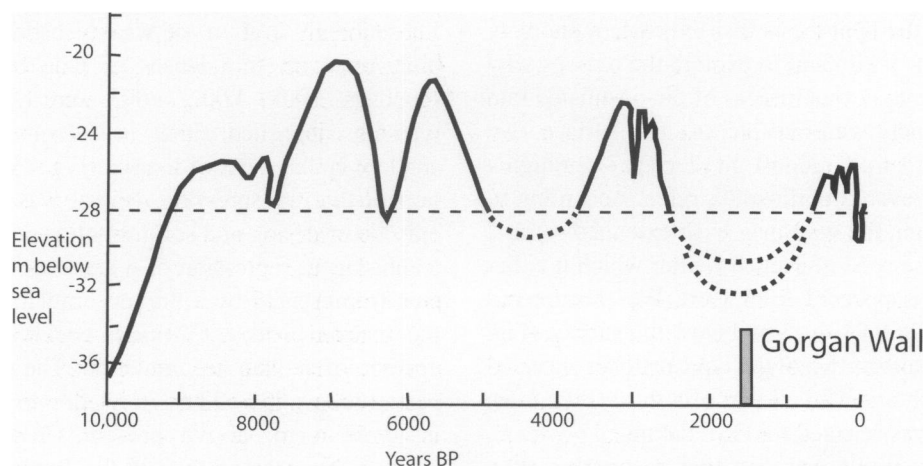


Fig. 10. Caspian Sea level curve with main phase of Gorgan Wall indicated (rectangle), based on Rychagov 1997: fig. 5.

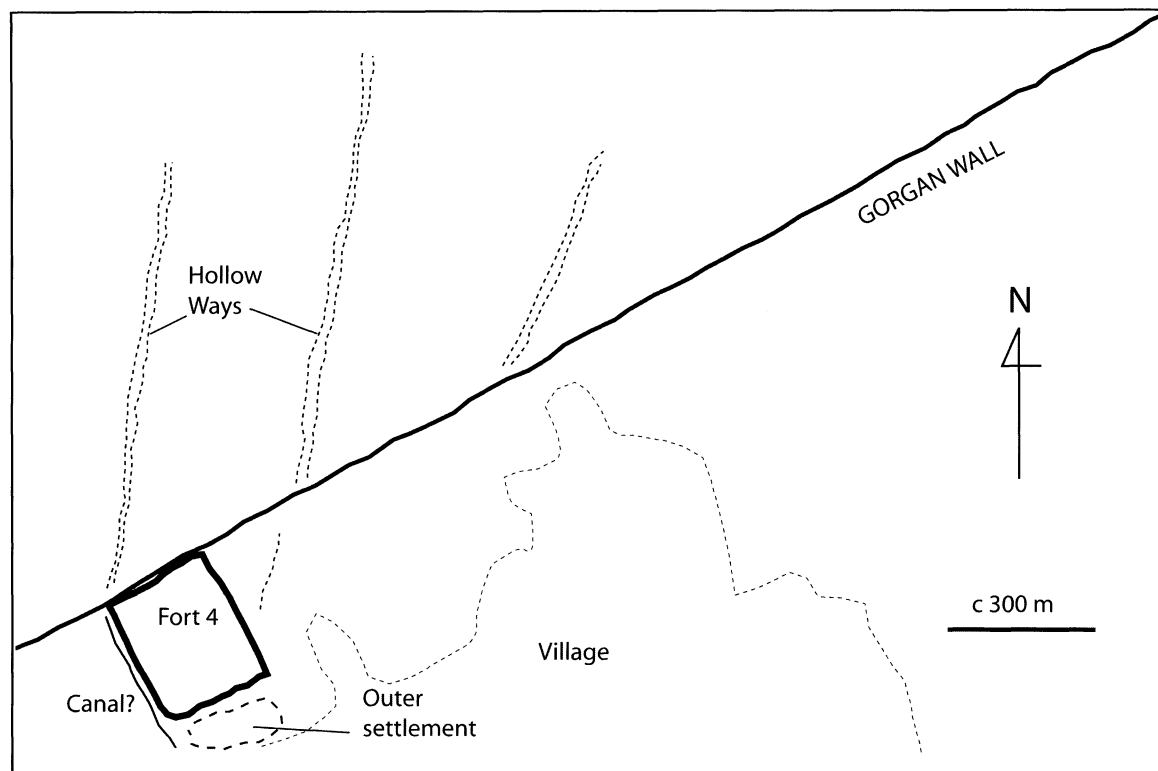


Fig. 11. Sketch map of Fort 4 and hollow ways.

represents a raised shoreline of the late or post-medieval Caspian transgression that inundated the wall and subsequently obscured it. To the west, the low ridge at Trench I appears to be a similar relict Caspian shoreline, but whether these two Caspian shoreline features, which are some 3.5 km. apart, relate to the same transgressive event or different ones requires further investigation.

The 1 m. deep marine deposits at this point explain for the first time why it has so far not been possible to follow the Gorgan Wall to the Caspian Sea. Relatively recent marine transgressions have buried the remains of the wall so deeply that neither features on the surface nor artefact scatters reveal its course. As there are neither traces of the wall, nor of a robber trench, it seems that it had been robbed out prior to being flooded. It is interesting to note that, despite its late flooding, no soil horizon had built up over the top of the kiln. This suggests that the top of the kiln was above ground and that the depth of marine deposits is probably greater next to the kiln. While the deep marine deposits have so far prevented a successful location of the westernmost stretch of the wall, it seems most improbable that the western terminal of the known section corresponds with the real terminal, which has been postulated before (e.g.

Huff 1981). Defensive logic dictates that the Wall would have continued until it either reached the ancient shore of the Caspian Sea, or possibly the Tammishe Wall, on terrain nowadays under the sea level.

VI. THE EASTERN PART OF THE WALL BETWEEN FORTS 2 AND 4 (HO & TW)

The Gorgan Wall is a massive feature within the landscape, and the maps made by M.Y. Kiani provide a very informative record of the wall, forts and other features within their landscape context. Now with the availability of high resolution satellite images, it is possible to recognise and interpret more features than was the case before, and the following text has benefited from the use of these, together with limited field checking in 2006.

As noted above, Fort 4 may have been associated with a cross canal that led water from the Gorgan River. Moreover, a high resolution Digital Globe image indicates that at the north-west corner of the fort a distinct "hollow way" can be traced leading northwards across the now cultivated steppe (Fig. 11). In addition, slightly less distinct

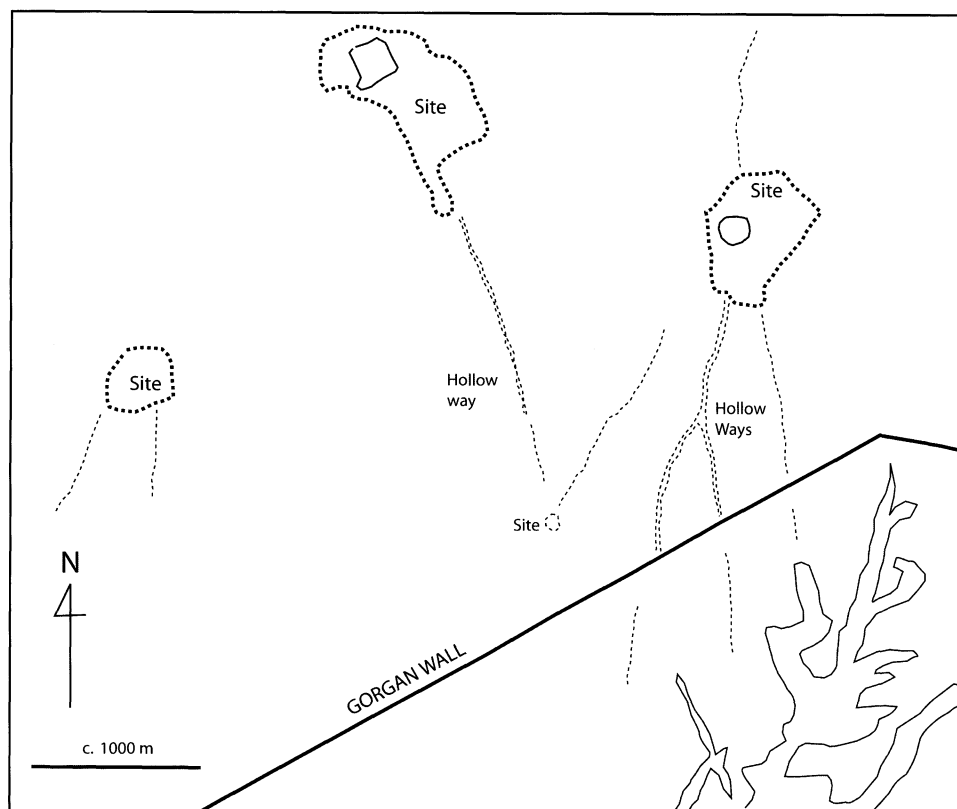


Fig. 12. Bend on wall between Forts 2 and 4 and sites with associated hollow ways.

features can be discerned c. 100 m. and several 100 m. to the east. In the Near East, hollow ways generally appear as broad shallow valleys (or soil marks) which radiate from archaeological sites, and they can be interpreted as having been worn down by the movement of people and thousands of animals over the centuries (Wilkinson 1993). Although a good case can be made for the north-west hollow way being associated with the fort and wall, those further to the east have more distinct traces to the north than to the south of the wall, and may therefore pre-date the wall. Although at Fort 4 a case can be made for the presence of a crossing point associated with the wall itself, the presence of the ditch as a continuous feature along this part of the wall suggests: 1) that the ditch at this point was dry when the track was in use, 2) that it was dry immediately to the east of the putative inlet canal, or 3) that the hollow way was in use before or after the wall was actively used, but not at the same time. Significantly, none of the hollow ways is oriented precisely upon what would have been gateways positioned in the centres of the north or south walls of Fort 4.

Further to the east, near the sharp obtuse angle bend in the wall between Forts 3 and 2, similar hollow ways

can be seen associated with the wall as well as with three associated archaeological sites to the north, that are beyond the limits of the wall (Fig. 12). Of these, the most distinct is the site to the north of the bend in the wall, which is associated with a distinct hollow way that trends south to meet the wall at the ditch, fades out at the wall itself, and then continues albeit with a more faded trace south of the wall (Fig. 12). A second hollow way bifurcates from the main feature and again continues south of the wall, whereas an additional faint hollow way to the west of the first, joins that feature to the south of the wall. Overall, the configuration of these hollow ways near the bend in the wall appears to represent a system of settlement and communications that pre-date the wall, and were then cut by it, although this suggestion needs to be tested by further fieldwork. Similarly, it is difficult to state whether the hollow way feature at Fort 4 was in use at the same time as the wall, or represents a pre-wall (or perhaps post-wall) feature. However, it is evident that with future fieldwork it should be possible to tease out some significant relationships between the wall and the route systems of the region.

Additional investigation of the eastern sector of the wall suggested that Fort 3, as designated by Kiani,

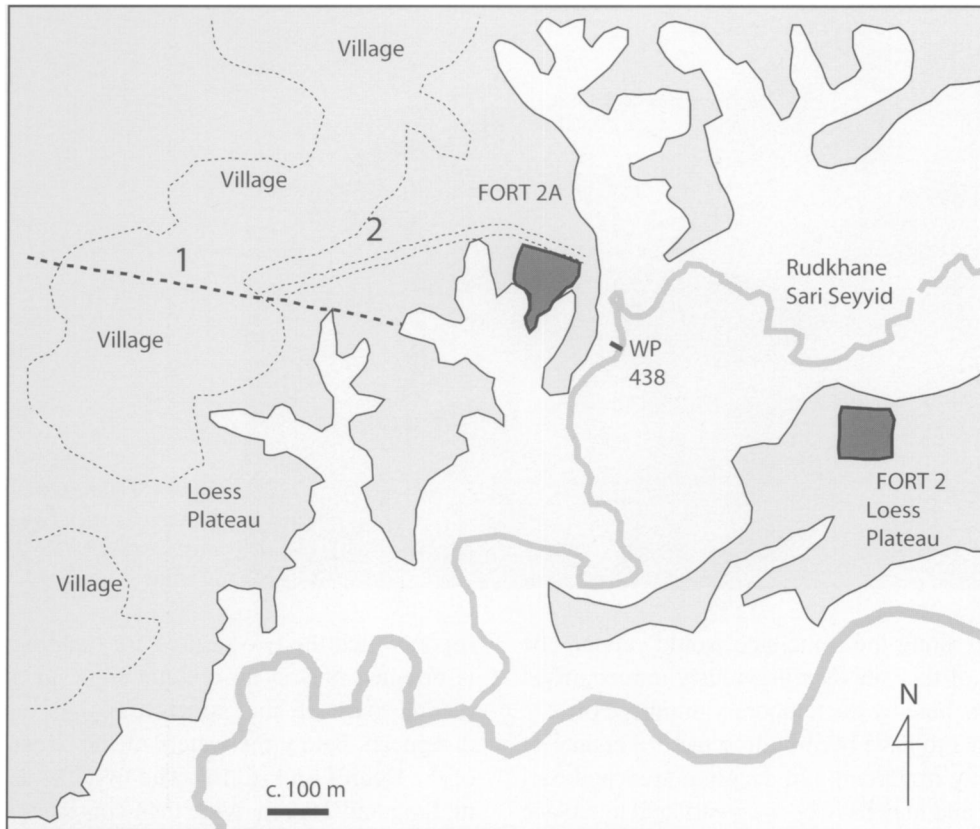


Fig. 13. Sketch map of Fort 2 area and associated sites.

does not now exist. In 2006, GPS navigation enabled us to pinpoint the location of the fort, and field investigations suggests that the small fort mapped by Kiani (1982: fig. 1) remains as only two groups of fired brick. One of these forms a small but prominent mound of fired brick on the wall itself, whereas the second consists of a low scatter of fired brick c. 170 m. to the south, adjacent and immediately north of the modern road. The only other evidence for cultural activity within the area where the fort should have been is a light scatter of pottery across the surface of the fields. The distance between the two scatters of fired brick, c. 170 m, falls within the dimensions of the Gorgan Wall forts and therefore Fort 3 may represent a “ghost” of a fort that was visible on the air photographs employed by Kiani, but is invisible today. There is no evidence that Fort 3 has been destroyed by agricultural activities, and it is therefore possible that either the feature was never completed, or that it was partly laid out (hence its visibility from the air) but the garrison was then moved to an alternative, perhaps more effective location. Interestingly the presence of a broad

gap in the wall, some 35 m. E-W, suggests that the Fort 3 was situated at a crossing point.

A short distance to the east of the bend in the wall, Kiani’s map records two branches of wall. Field checking in 2006, as well as inspection of Digital Globe images, suggests that the northern arm is associated with a broad ditch with associated bank/ wall to the south, whereas the southern branch has the same narrow trace as the main wall ditch to the west, and continues the line of the wall to the east on a direct alignment with Fort 2 (Fig. 13). On the northern limb of the wall the site of a possible fort had been recognised (by Hamid Omrani) (Fig. 13: 2A). This site occupies an important strategic location on the high western bluffs of the Rudkhane Sari Seyyid (a river), where the Gorgan Wall apparently terminated before resuming its course to the east at Fort 2. This previously un-recorded site (it is not evident on the maps of Kiani) lacks the distinct square plan of the other forts, and is heavily pock-marked by abundant robber pits. A brief survey of this site (near the village of Tamar Gharaghuzi) showed that a linear mound along the western side, as well as an



Fig. 14. Feature of Gorgan Wall bricks at east end of wall between Fort 2 and 2A. (See Fig. 13 for its location.)

apparent moat along the same side would support the identification of this site as a previously unrecognised fort, referred to here by the temporary number Fort 2A. Fort 2A appears to have been built to have oversight of the strategically important and deeply entrenched Sari Seyyid River, and may have been constructed to replace Fort 3, which was not positioned at an important strategic location within the landscape. More significantly, the existence of two distinct branches of the wall, with quite different morphologies and on different alignments, provides compelling evidence for the existence of two phases of the wall at this point. In terms of morphology and alignment, the first phase would be the southern feature and the second phase would be that to the north (Fig. 13, 1 and 2 respectively). Why the construction of two phases was deemed necessary is difficult to say, but it is possible that the first, southern phase of the wall was destroyed or compromised by the deep, rapidly eroding gullies that were eroding back from the Sari Seyyid River, and that it was necessary to circumvent them with a later phase of wall further to the north.

In the floor of the valley of the Sari Seyyid River, an apparent part of the Gorgan Wall complex has been noted (by Hamid Omrani). This substantial feature of fired brick (Figs 13, “WP 438” and 14) is located in the bed of the flowing river. It consists of two lengths of wall or platform made of Gorgan Wall fired bricks. The first oriented at 233 degrees magnetic is at right angles to the main channel of the river, whereas the second

(upon which the two figures are standing on Fig. 14), is oriented N-S at an oblique angle to the first. This second part of the structure points upstream and disappears below the waters of the stream (to the left of the figures on Fig. 14). The first element which is 8 m. long and 2.16 m. wide then continues into the west bank of the river as is evident from a deep cut into the hardened river sediments. Laid out at an angle of 137 degrees to this, the second fired brick structure forms a platform on the bed of the stream. Part of this is submerged beneath the waters of the river, but is still visible and measurable by wading in the water. Although the 2.16 m. wide segment of wall could be a component of the Gorgan Wall, the platform built obliquely to it is intriguing. Being apparently constructed within the bed of the river, this feature could be reasonably described as “hydraulic”, and its location a few hundred metres off the course of the wall suggests that it is not strictly on the wall’s line. One possible interpretation of this structure is that it does indeed represent a short length of wall in the valley floor, and that the fired brick platform may represent an apron that was constructed to conduct water beneath the wall at a point where an arch was constructed to allow the water free passage. Without such a reinforcing apron, the river could incise into its bed and scour out the foundations of the wall. Although tentative this interpretation gives an insight into the sophisticated engineering of the Sasanian architects.

VII. THE GORGAN WALL IN ITS LANDSCAPE: DISCUSSION AND CONCLUSIONS (TW & HO)

The presence of five well-defined feeder canals suggests that rather than forming one continuous water supply system, the ditch associated with the Gorgan Wall was probably sub-divided into separate water supply sectors (Fig. 1).

1. The easternmost sector, to the east of Fort 2, has not been examined for evidence of water supply, but it is clear that it would have been difficult to have brought water from this sector to the sector west of Fort 2A.
2. Between the Sari Seyyid River, and the tributary that enters the Gorgan River west of Fort 4. This sector may have been supplied with water from the probable feeder canal adjacent to Fort 4, as well as from an unknown source to the east.
3. The sector to the west of Fort 5 provides the best evidence for a system of water supply linked into the construction of the wall. It is clear that this system cannot have received water from sector 2 (between Forts 2A and 4) because the deep valley between Forts 4 and 5 shows no sign of having been equipped with the complex engineering systems required to transmit the water from the east to the west banks. Overall, the entire stretch west of Fort 5 appears to have constituted one hydraulic system, with the ditch being evident along much of

this length. The presence of an embankment east of Fort 15, reinforces the observation that the wall followed a hydraulic gradient, and it appears also that the Digje canal, between Forts 16 and 17, may have been part of the same water supply sector as the Aghabad canal. The role of water supply in the main sector of the wall (i.e. west of Fort 5) is supported by the clear relationship on Digital Globe images between the Garkaz dam and the canal that led towards the wall, as well as the evidence for upcast banks on the Aghabad canal.

Although it is not possible to unambiguously distinguish specific crossing points through the wall, the presence of hollow ways at Fort 4 as well as to the east near the bend in the wall, suggests that such crossing points can be recognised, and that in places the wall may have actually been constructed over pre-existing settlements and their associated local route systems. The presence of two lines of the wall between Forts 2 and 2A, suggests that allowance must be made for two phases of wall construction, at least at the east end of the wall. On the other hand at the west end, near the Caspian Sea, the wall has been obscured by deposits from a high late and post-medieval stand of the Caspian Sea, but whether the wall terminates to the north of Gumishan (presumably at the edge of the Caspian Sea) or turned south to eventually link up with the Wall of Tammishe (see below “X. *The Gorgan and Tammishe Walls* ... pp. 112–3”), remains an open question.

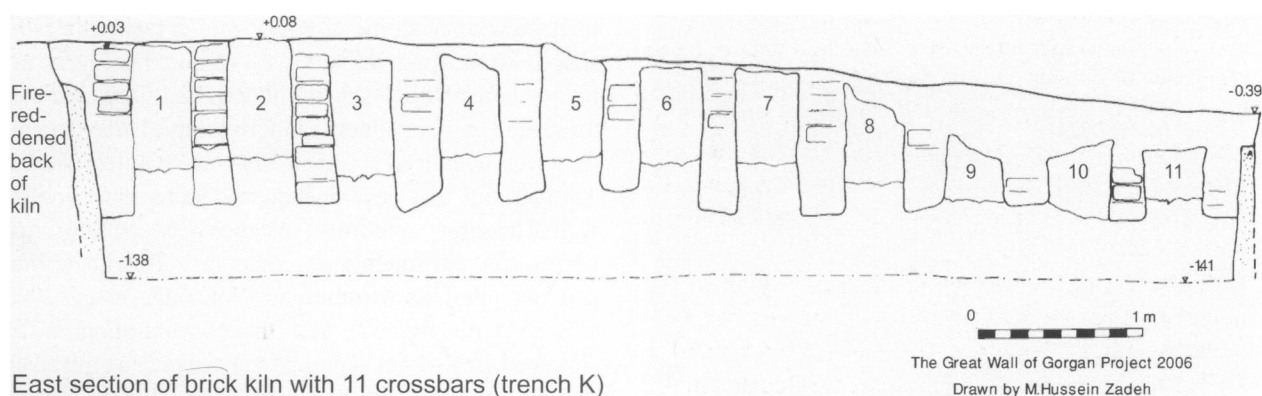


Fig. 15. Trench K: west-facing section of kiln cut by a recent drainage ditch, drawn by Maryam Hussein-Zadeh.

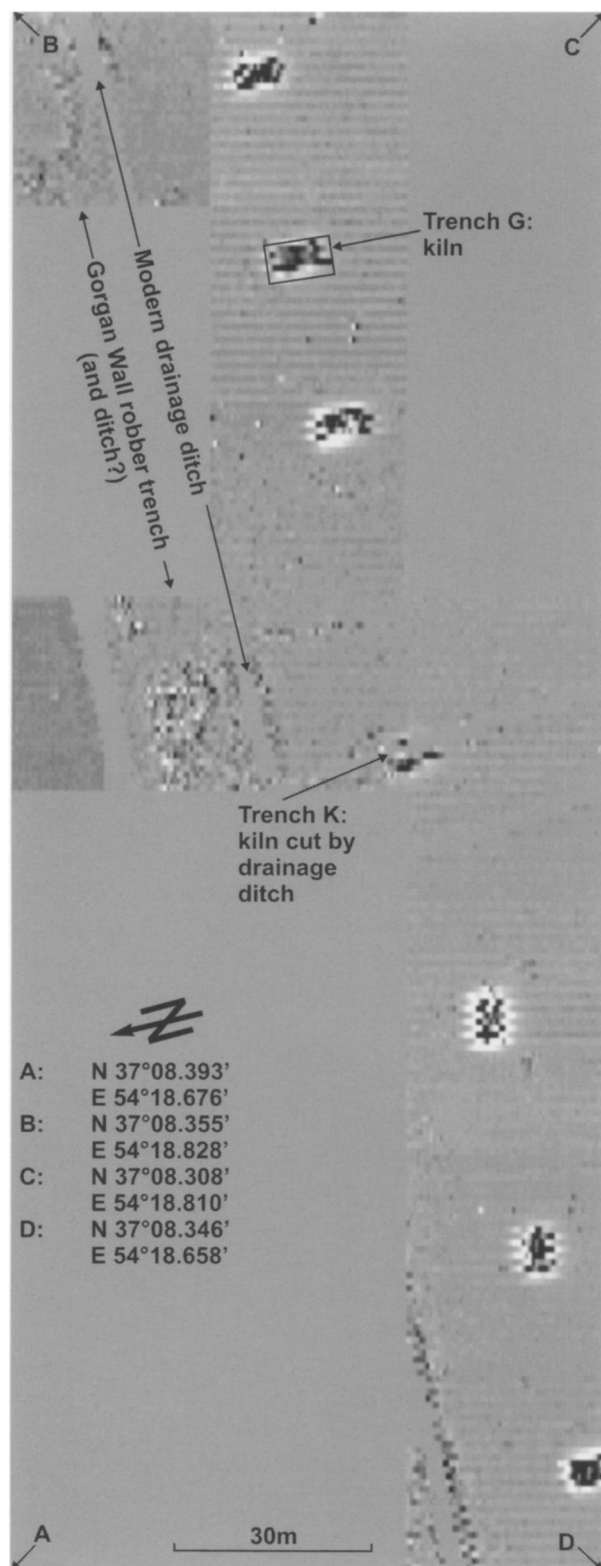


Fig. 16. Magnetometer survey of the Gorgan Wall and seven associated kilns, c. 1.3 km. west of Fort 30, with the location of Trenches G and K, by JR, SG and HO.

VIII. SURVEY OF A BATTERY OF BRICK KILNS WEST OF FORT 30 (HO, EWS, JR, SG & AN)

Approximately 1.3 km. west of Fort 30 one brick kiln had been cut through by a recent drainage ditch (Figs 15–16) and a series of shallow mounds in its vicinity, all roughly equidistant from the robbed-out Gorgan Wall, suggested that there was a whole series of kilns. In order to evaluate this hypothesis, James Ratcliffe, Seren Griffiths and Hamid Omrani carried out a magnetometer survey of a 240 m. long area (Fig. 16). We hoped that this survey would not only provide valuable insights into the scale and organisation of brick production, but would also allow us to identify a well-preserved kiln for excavation and dating.

The survey identified a remarkable concentration of kilns south of the wall: three to the west and three to the east of the kiln cut by the drainage ditch, i.e. no less than seven within just 220 m. (centre to centre). Their distance to each other (on average 37 m.) and their orientation (some parallel or near parallel and some at a right angle to the wall) varied. However, as far as a survey allows us to tell, the centre points of all seem to be on the same alignment and all appear to be of similar dimensions. We cannot assume that a similar concentration of kilns existed at all sections of the wall. While suitable material was available at all sections, water may have been more of a problem, even though most sections seem to have been supplied by canals (Nokandeh *et al.* 2006). In the central section east of Gonbad, kilns have been identified in the Gorgan river valley, which may have produced bricks for the wall as well. Nevertheless, the discovery of yet two more kilns, spaced 86 m. apart, 4.8 km. west of Fort 33 (Fig. 7) at a point where no brick slag or mounds had suggested their presence (i.e. a genuinely random sample), may suggest that a comparatively narrow spacing of kilns was not atypical and that several thousand kilns may line the wall. The same, in terms of distance between kilns, may be true for the roughly contemporary Tammishe Wall and our previous assumption (Nokandeh *et al.* 2006: 153–55 with fig. 32) that the concentration in the surveyed area was exceptional may have been mistaken. The high number of kilns is somewhat surprising, as one would have thought that building fewer kilns and reusing them more often would have been more economic, even if it would have resulted in a slight increase in the average distance between production and construction site. It seems hard to explain why those

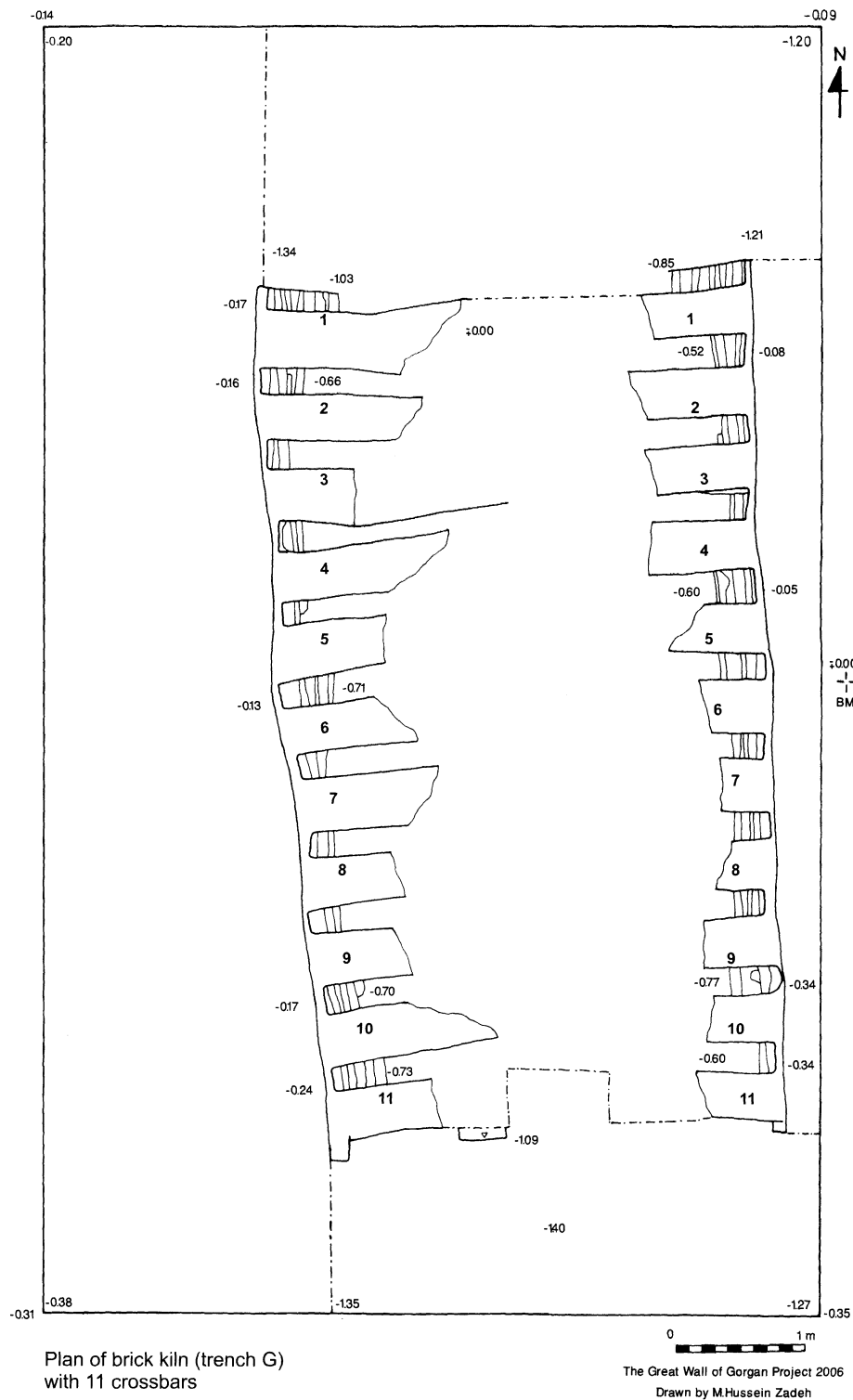


Fig. 17. Plan of Trench G, drawn by Maryam Hussein-Zadeh.

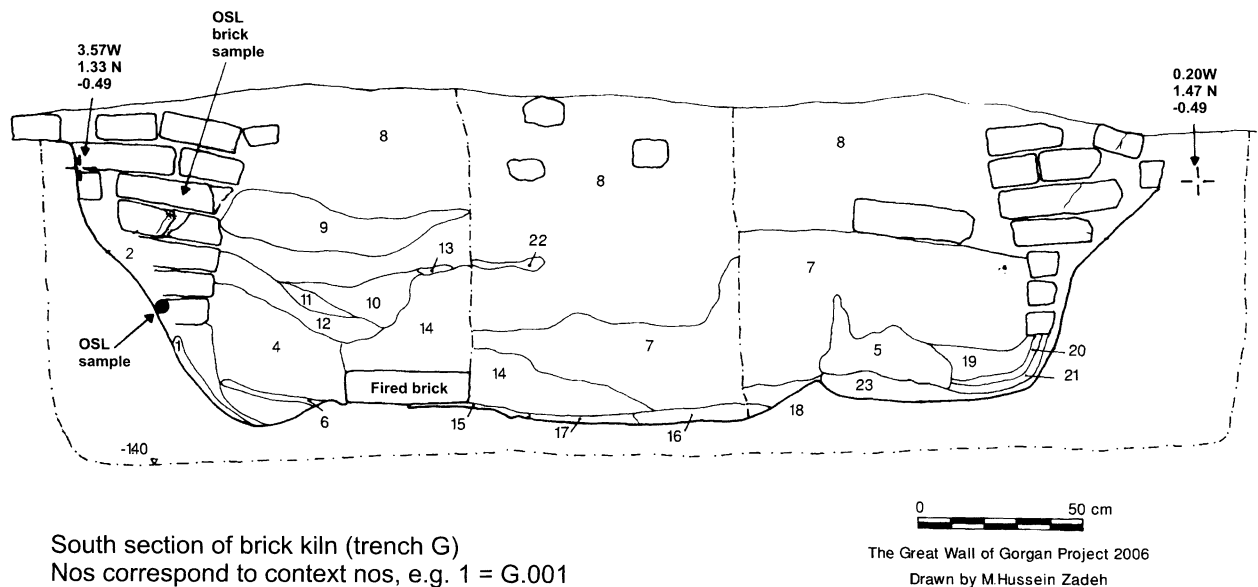


Fig. 18. South-facing side of the kiln in Trench G, drawn by Maryam Hussein-Zadeh.

building the wall did not reuse a smaller number of kilns more often. Possible reasons for the narrow spacing of kilns include the wall being built under great pressure of time and using a larger and more skilled workforce than previously thought, and/or that it reached a greater height.

IX. EXCAVATION OF A BRICK KILN (HO, EWS, MM & SG)

In addition to the one kiln cut through by a recent drainage ditch, whose section was cleaned and recorded in Trench K (Fig. 15), another kiln (Trench G) was excavated (Figs 16–20) under the direction of Hamid Omrani and Majid Mahmoudi. Both kilns had been cut into the natural soil. Like the kiln in Trench A, they both comprised eleven crossbars. The dimensions of the Trench G kiln (6.60 × 3.60–3.80 m.) were smaller than that of the kiln excavated in 2005 in Trench A (Nokandeh *et al.* 2006: 130–35) and that excavated by Kiani (1982: 17, 18 fig. 11) at Fort 13, as were the associated square bricks with a side length of just 0.37 m. In all three cases the upper width of the kiln corresponds roughly to ten bricks; the kilns appear to have been designed for ten stacks of bricks sideways and 17 or 18 stacks lengthwise, i.e. 170 or 180 stacks in

total. The width of the kiln is similar to its partially excavated counterpart on the Tammishe Wall (Nokandeh *et al.* 2006: 154 fig. 33), a possible indication for the attribution of these two kilns and, by implication, the two walls to the same building programme. Unlike the Trench A kiln and the kiln on the Wall of Tammishe (Trench F), the arches of the Trench G kiln did not survive to their full height, but had collapsed (Fig. 19).

The main purposes of the excavations of the kiln were to gain insights into its architecture and to obtain further scientific dates for its firing and thus, almost certainly, for the construction of this section of the Gorgan Wall. It seemed important to date the western section of the wall, as all 2005 dates were based on samples from the central and eastern sections (Nokandeh *et al.* 2006: 158–63); the dating evidence presently available does not allow us to decide whether the Tammishe Wall and the sections of the Gorgan Wall west and east of the Pishkamar Rocks were all built simultaneously or successively and whether construction works were completed within a few years or decades (as seems likely) or may have lasted for anything up to one and a half centuries.

The southern and northern side of the kiln were excavated, but virtually none of the interior, except for a small sondage in the south (Figs 17 and 20). In the light

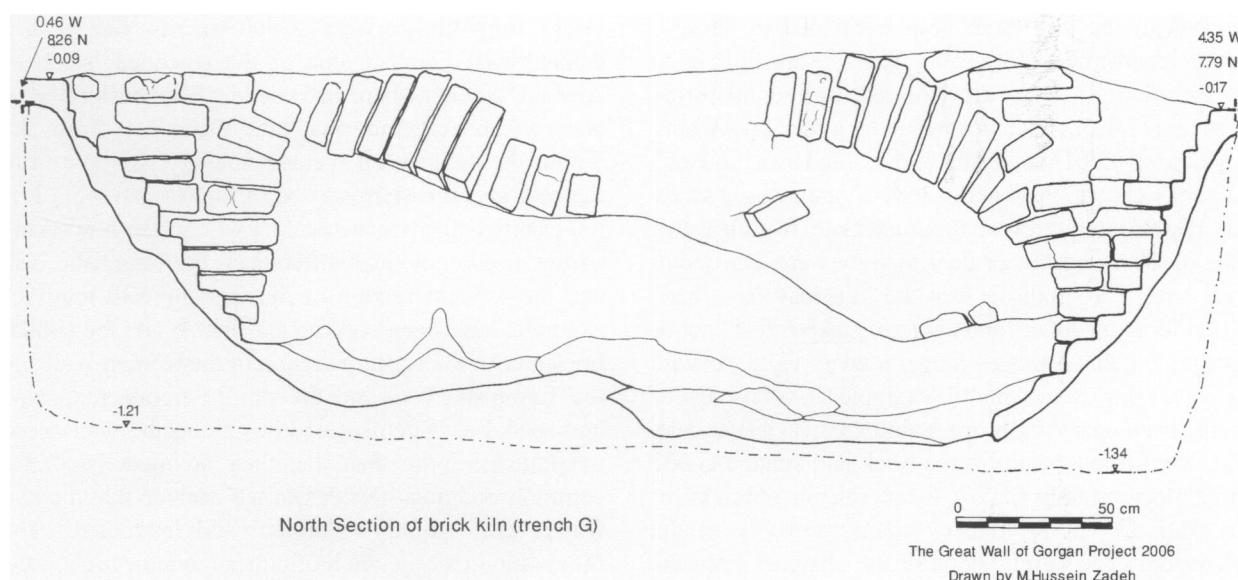


Fig. 19. North-facing side of the kiln in Trench G with collapsed arch, drawn by Maryam Hussein-Zadeh.

of the lack of excavation of the interior, our understanding of the history of the kiln is limited and what we can deduce from the sections shall thus be summarised rather concisely. There is no doubt that the kiln was used. A thin well-defined band of dark brownish black silty clay (context G.001, Fig. 18) is best explained as a wooden plank for the revetment of the kiln charred *in situ*, as first suggested by Seren Griffiths. The intense heat even led to the fire-reddening of soil (context G.002) behind the

arch and thus not exposed directly to the fire. Contexts G.020, G.021 and G.023 also represent fire-reddened deposits. Brick slag (G.005), deposited on the south-facing side of the kiln is further evidence for the high temperatures reached during firing. G.015, G.016, G.017 and G.018 were rich in charcoal. Unlike the north-facing section (Fig. 19), there were no signs that the arches had collapsed into the interior in the southern section—and in the case of the northern section this appears to have



Fig. 20. The kiln in Trench G seen from the south. Each segment of the scales corresponds to 0.50 m.

happened at a time when much of the interior of the kiln had already silted up. Too little of the post-abandonment deposits in the kiln have been excavated to allow a certain reconstruction of events. There seems little point in speculating what an isolated horizontal brick overlying G.015, which is overlain by a dark brown silty clay deposit (G.014) or a later re-cut, filled by a brownish red sandy clay (G.004) with a lens of orangey red sandy clay (G.006) might reveal about later use. It is clear that none of these deposits or their vicinity were exposed to great heat. They indicate that the kiln may have been reused for some other function (e.g. makeshift shelter or storage), but that it was no longer used as a kiln. As with the other kilns excavated, this example shows no sign of having been reused in its original function at a later date. The OSL sample taken from a brick and context G.002 thus almost certainly relate to the production of bricks for the Wall. Except for narrow stems, probably of the *Chenopodiaceae* family, none of the charcoal from the fill of the kiln was identifiable (see below “*XX.2. Charcoal Analysis*” pp. 132–3). Whether or not the scarcity of identifiable charcoal may be the result of the use of dung fuel in what is, nowadays at least, a treeless landscape is impossible to establish with certainty. Dung fuel would be more likely to disintegrate into small particles which are hard to identify (Rowena Gale, pers. comm.). The results of the radiocarbon dating of these charcoal and the OSL samples are, unfortunately, not yet available.

Little would be gained by a detailed scrutiny of the remainder of the fill of the kiln. Successive deposits vary in the proportion of brick fragments. They almost certainly represent the gradual build-up of material while parts of the superstructure crumbled and were probably partially robbed, while natural soil and brick debris were washed into the interior. The noticeable reduction of brick fragments in the latest fill (G.008) suggests that the final silting up post-dates the postulated robbing of any remaining upstanding arches.

X. THE GORGAN AND TAMMISHE WALLS: TWO SEPARATE MONUMENTS OR TWO PARTS OF A SINGLE WALL? (JN, HO & EWS)

Scientific dating carried out in 2005/06 (Nokandeh *et al.* 2006: 158–63) suggests strongly that the Tammishe Wall is either contemporary with the Great Wall of Gorgan or that the two walls are at most a century apart.

As noted above, the bricks from the excavated kiln west of Fort 30 had a side length of just 0.37 m. Interestingly, bricks from further west, which we saw reused in a cemetery on Gomish tepe or the so-called Island of Abskun, at Gumishan, had identical dimensions. It is also worth remembering that the kilns from the Tammishe Wall are on average smaller than those from the central and eastern section of the Gorgan Wall. It is not clear whether we are dealing with different working parties or chronological differences; the Tammishe Wall and the western section of the Gorgan Wall may, for example, have been constructed first. While the similar brick size of the western section of the Gorgan Wall and the Tammishe Wall and the similar architectural type and spatial arrangement of kilns along the walls need not indicate more than that their architects shared a common tradition, neither can we exclude that the two walls were jointly planned and executed. The observation that the ditch of either monument is on the same side (i.e. facing away from the Gorgan Plain) may offer further circumstantial evidence for the walls belonging to a single monument, and proves in any case that the Tammishe Wall, with its ditch in the west, was not primarily designed as a second line of defence behind the Gorgan Wall. If the Bansaran Fort was part of the original scheme, despite its unusual location outside the Tammishe Wall, then its earth platform is also a common feature with the Gorgan Wall forts. It is even possible that the two walls were part of a single monument, the missing link being on land now flooded by the Caspian Sea (a theory first advanced by Jebrail Nokandeh and Hamid Omrani in 2002).

It may be significant that the westernmost known part of the wall seems to curve southwards, especially if the concentration of Gorgan Wall bricks from on and around Gomish Tepe and Gumishan indicates that the wall passed their vicinity (Kiani 1982: general map; Talbert 2000: map 96 plotting the wall and “Gumush” = Gomish Tepe). While it is, of course, possible that robbed bricks were brought to these sites from some distance, the sheer number of Gorgan Wall bricks in old buildings in Gumishan and scattered in and around Gomish Tepe, now and already in the late nineteenth century (Yate 1900: 272–73; Adamec 1981: 200–1), renders it more likely that the wall was in close vicinity. Yate (1900: 273; cf. 226–27, 260–61; Adamec 1981: 201), during his visit in 1894 to various sections of the Gorgan Wall and other sites in the area, heard of a “report that bricks were to be found under the water some distance out in the sea”, the

coast at the time apparently being only “a good half-mile” west of the mound of Gomish Tepe; this suggests that the Gorgan Wall, like the Tammishe Wall, ran into terrain flooded by the Caspian Sea. Joining the Gorgan and Tammishe Walls would have prevented enemies from bypassing the system using boats. There is no parallel, to our knowledge, in the ancient world of a long wall running along a seashore, other than to protect cities, the reasons being that many of Rome’s and Persia’s northern enemies had no, or extremely limited, experience in seafaring. More importantly, in most instances (e.g. Britain or the Peloponnese) the length of vulnerable shores exceeded that of the defended narrow land corridors many times over. It would have been impossible to effectively protect the shores through barriers. By contrast, the gap between the westernmost known point of the Gorgan Wall and the Tammishe Wall was substantial at *c.* 32 km. as the crow flies from Gomish Tepe to the northernmost traces of the Tammishe Wall or associated fort in the Caspian Sea, but limited in relation to the 200 km. combined length of the known sections of the two walls. This gap could have been closed if there was a desire to do so, but this does not prove, of course, that it was, and it is equally possible that they were indeed two separate walls and that both terminated at the ancient shore of the Caspian Sea.

Should the Gorgan and Tammishe Walls be part of the same wall, the missing link being partially flooded by the Caspian Sea and partially buried beneath marine sediments, then there were presumably further forts along this section. This would have implications for the size of the wall’s garrison, to be discussed in the concluding chapters.

XI. MAGNETOMETER SURVEY OF FORT 5 (RA, HO, EWS, EST, SG, ME & JJ)

Crucial for understanding the purpose and history of the Gorgan Wall are the size and composition of its garrison, and the strategy it employed to defend the Gorgan Plain. In order to shed light on these key issues, we continued to explore the interior of forts via geophysical survey. Only a part of Fort 5 was surveyed. For this and for the Fort 4 survey, a Bartington Grad 601/2 gradiometer with 1 m. line spacing was used, for the other surveys, a Geoscan FM256 Fluxgate Gradiometer. The results confirmed that the Great Wall of Gorgan, where it forms the north side of the fort, was made of fired bricks (as appears to be true for

the entire wall). No clear traces of interior buildings emerged, but it is impossible to tell whether there were none or, more probably, they did not cause sufficiently strong anomalies to be detectable. Parts of the fort have served as a modern graveyard and a large burial enclosure and tomb-markers, consisting of reused bricks, may have contributed to the lack of clarity of the survey.

XII. THE BUILDINGS IN A SASANIAN FORT: MAGNETOMETER SURVEY OF FORT 4 (EWS, HO, RA, EST, JJ, ME, SG & AN)

The 2005 geophysical surveys of Forts 1, 9 and 10 (Nokandeh *et al.* 2006: 125–29, 142, 151), and the 2006 survey of Fort 5, had yielded rather inconclusive results on the nature of these forts’ interior occupation. The density of artefacts from fort interiors and an excavated section through the ditch at Fort 9, as well as more general considerations on defensive strategy, nevertheless suggested strongly that the interiors of the forts on the Gorgan Wall housed sizeable garrisons, probably accommodated in structures made of materials which are hard to detect magnetically.

It thus came as a pleasant surprise that the 2006 magnetometer survey of Fort 4 (Figs 21–22), by Abingdon Archaeological Geophysics and the ICHTO, under the direction of Roger Ainslie, provided us with astonishingly clear results. On either side of a NW–SE-running central road we found two parallel anomalies of *c.* 228 m. length. The regular subdivisions leave no doubt that these have to be interpreted as elongated buildings, divided into two parallel rows of rooms. A third, virtually identical, anomaly, parallel to the other two was detected in the SW of the fort. At first sight, the plot may suggest that there are six rather than three such buildings, each of the three long double rows of rooms divided in the middle by a road, running from SW to NE. However, while further fieldwork will be necessary to prove or disprove this theory, this route, which is now visible as a shallow hollow way, is probably a secondary feature. The linear anomalies, thought to be walls of the three buildings, do not appear to come to an end on either side of this track, but to run across it, suggesting that we are dealing with three very long, rather than six shorter, buildings. The absence of any suggestion of a SW or NE gate in alignment with this track is a further argument for it being a secondary feature, perhaps added in a later phase to facilitate movement from the

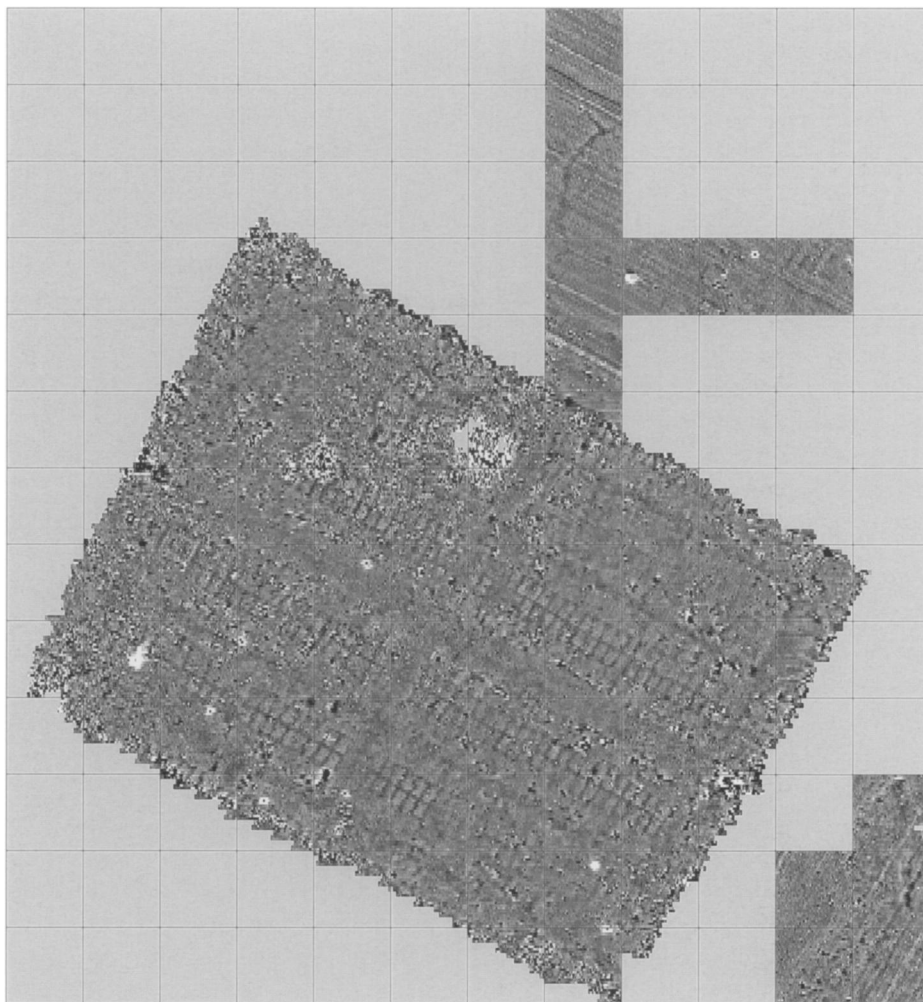


Fig. 21. Magnetometer survey of the interior of Fort 4 and selected extramural areas by RA (Abingdon Archaeological Geophysics), HO (ICHTO), EST, JJ, ME, SG & AN. For scale and north arrow see Fig. 22.

buildings to the south-western and north-eastern defences.

Unfortunately, a cemetery in the northern part of the fort, comprising modern gravestones, circular and square burial enclosure ditches, mounds and monuments built of reused fired brick, made it impossible to detect the precise extent of these ancient buildings. While we cannot be absolutely certain, there is nothing to suggest that the three buildings varied significantly in size or room divisions. The remarkable regularity of the fort's layout offers support for the assumption that they were intended to be identical. If so, it may be permissible to reconstruct one block's obscured parts on the basis of detected sections of another. Counting the rooms in clear sections of the plot and dividing the approximate length of the buildings by

the average NW–SE extent of a room, allows us to estimate that each block contained *c.* 45–48 pairs of rooms, or a total of 90–96.

The regular layout and room size in the three blocks suggests that they served as accommodation for the fort's garrison. It is also possible that some may have been used as stables or storage facilities or for multiple purposes, or that their function changed over time. The standardised design suggests in any case that all rooms were either intended for the same purpose or designed to be adaptable for a range of functions. There are no distinctively larger rooms (or at least not in those parts of the plot which are sufficiently clear), as one might have expected for officers' quarters. Neither are there any rooms or recognisable separate buildings for special functions, be it storage, administration, caring for the

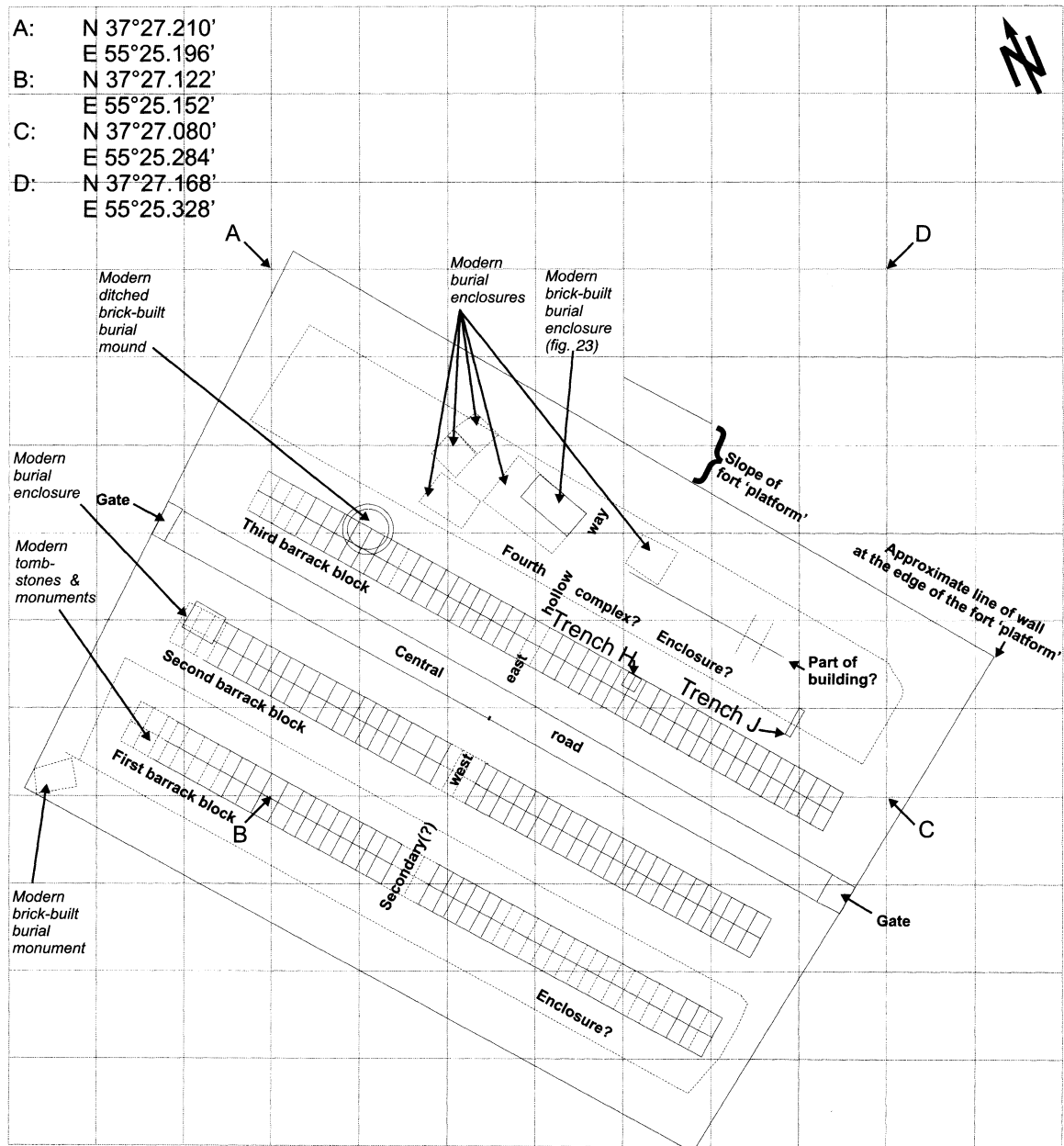


Fig. 22. Interpretative plot of Fort 4 with the location of trenches H and J. Each grid corresponds to 30 × 30 m. The projecting towers are not plotted as they cannot be pinpointed on the magnetometer survey. Only some of the modern burial enclosures and mounds have been plotted. They have not been surveyed and their extent is only approximate.

sick or wounded or repair or production of equipment. Furthermore, the absence of parallels for non-standard rooms or buildings in the other, admittedly few and largely unexplored, “Barracks Forts” (see below “XVI. Sasanian Fort Design” pp. 127–8) renders it more likely that this fort contained exclusively buildings of similar design, catering for all required functions and for ordinary soldiers and officers alike. David Oates’ (2005:

91–92) hypothesis that the “Barracks Forts” were designed to train recruits, which, as he concedes, is “undeniably speculative”, is unlikely to be the correct explanation for what appears to be emerging now as the main (or at least one of the main) fort type(s) in the border zones of the Sasanian Empire.

Instead it is worth pointing out that many late Roman forts also seem to contain far fewer, if any, specialised



Fig. 23. A modern burial enclosure made of reused Gorgan Wall bricks (see Fig. 22) and the magnetometer survey in progress.

buildings and no overtly high-status accommodation. Gundolf Precht (1987), for example, postulates that in the late Roman fort at Cologne-Deutz, the central four barracks, which differed from the remaining 12 by a short portico only (as far as the small-scale excavations allow to tell), were reserved for officers and administrative functions. It appears that in both Sasanian and late Roman forts precious space and resources were normally no longer expanded on unnecessarily lavish accommodation for higher-ranking army members. The similarities between Sasanian and late Roman military architecture in the interior layout of forts and their defences (e.g. the widespread use of projecting towers, see below “*XIII. Topographical Survey of Fort 4 ...*” pp. 118–20) or in linear barriers are unsurprising. There is no reason to think of this as a one-way flow of influences, whether from east to west or from west to east; in most periods of history, e.g. the recent Cold War, competing “superpowers” have used similar military strategies and technology, copying each other’s innovations, improving on them and adapting them to local conditions. The frequent comparisons between Sasanian and Late Roman monuments in this article are thus necessary to identify common and diverging trends in the defensive architecture of the major empires of the time, and to reveal the sophistication and significance of Sasanian architecture on a global scale.

A fourth complex was detected in the NE. It forms an enclosure of c. 35 m. width and, though its traces fade

away in the NW, probably a length similar to the barrack blocks (Figs 21–22). There is a suggestion of a possible enclosure of similar width around the barrack block in the SW (Figs 21–22). Although it is possible that we are dealing with a road grid, it is tempting to assume that these postulated enclosures served specialised functions (e.g. corralling horses, beasts of burden or livestock). In the centre of the complex in the NE there is (like the three parallel blocks) an elongated mound today, suggesting it equally contained a collapsed mud-brick building (and was not an empty enclosure). In common with the little we know from the other “Barracks Forts”, it may have been a fourth barrack block, which, for unknown reasons, was not detected by the survey. Faint traces of a NW–SE running linear anomaly along its axis of symmetry, and possible traces of linear anomalies at a right angle to it, may offer support for this latter hypothesis.

The magnetometer survey also yielded interesting insights into the defences of the fort. The higher concentration of high readings on all four sides of the fort (Fig. 21) suggests strongly that fired brick was employed not just on the NW side, where the fort abuts the Great Wall, but on the three other edges as well. Further research is needed to establish whether this is true for all or a proportion of the forts or whether Fort 4, as one of the largest, if not the largest, fort on the Wall, was more heavily defended than some of its counterparts. The

survey of Fort 1 had yielded no positive indications of fired bricks being used at the sides other than the one abutting the Great Wall (Nokandeh et al. 2006: 126–27 with fig. 3), but further research is required to decide whether this reflects architectural differences between Forts 1 and 4 or differences in the thoroughness of modern brick robbing. The extensive reuse of fired brick in modern funerary monuments in Fort 4 (Figs 22–23) is symptomatic of brick robbing which affected, to a greater or lesser extent, all forts and all sections of the wall.

The two high anomalies on either end of the central road are particularly interesting. The south-eastern is marked by a dense scatter of smaller brick fragments on the ground, while none are visible on the surface in the area of the north-western anomaly. The location of the anomalies suggests strongly that we are dealing with the remains of gates. The south-eastern of these appears to have been robbed out, a theory strengthened by the presence of a robber trench just inside the fort and the brick scatter continuing, in alignment with the road, down the slope of the platform. By contrast, parts of the foundations of the north-western one are possibly still preserved *in situ*. The width of the north-western anomaly corresponds to that of the road and its rectangular shape suggests that we may be dealing with deeper foundations than those of the adjacent sections of the wall, perhaps not reached when the wall was robbed out. Normally, however, the gate opening does not require deep foundations, if any foundations at all, as it carries no weight. Alternatively, it is thus possible that we may be dealing with the later blocking of the road leading out the fort, but this would only have made sense, had there been a gate before. The magnetometer survey thus suggests strongly that Fort 4 had a gate on the enemy side. Whether this was intended mainly for military sorties or also to enable and control traffic between the territories divided by the wall cannot be decided on the basis of the evidence presently available. The observation that none of the hollow ways leads towards the gate (see “VI. The Eastern Part of the Wall ...” pp. 103–6, with Fig. 11) suggests that there was only limited traffic passing through this gate. The hollow ways could, of course, date to a potential post-military phase (see “XIV. Daily Life ...” pp. 120–6) and deliberately bypass the obstacle of the ruined fort. Any potential visitors from the north using the route through the fort would have had to walk past two military buildings of over 200 m. length on either side of the central road. Such a symbolic demonstration of Persian

military might and organisational skills probably would have suitably impressed any members of nomadic groups admitted into territory south of the wall, whether they were involved in trade or political negotiations. Even if no more than the odd embassy were allowed access, the impressive scale and regularity of the architecture of the fort would have sent out a deterrent message to any neighbours contemplating a raid into a state with such a highly organised military force. Without further fieldwork we cannot be certain whether Fort 4 was special in having a gate on the enemy side or whether most other forts on the wall were designed for military or civilian traffic with territories beyond the wall as well.

According to Kiani (1982: 15 fig. 9), Fort 4 was the largest military establishment on the entire wall. However, Kiani’s estimates for the dimension of forts are rounded, and may have been measured, on the basis of aerial photographs, from the bottom of the fort platforms and inner edges of the surrounding ditch, rather than the edge of the defended interior. Thus for Fort 4 his figures are 240×300 m. (= 7.2 ha.), while the interior is only c. 200×268 –78 m. (= 5.5 ha.), i.e. a c. 32% overestimation. For Fort 1, Kiani’s dimensions had equally been too high (by c. 23% [Nokandeh et al. 2006: 128]). Without independently measuring the size of all forts, we thus cannot be absolutely certain whether, in relative terms, Fort 4 is indeed the largest of all forts on the Wall. However, Kiani’s very accurate maps (Kiani 1982: figs 1–8b) equally suggest that no other fort on the wall exceeded it in size. Being the largest, or one of the largest, forts it is possible that it held a stronger garrison and a higher-ranking commander than other forts. This need not mean that it was necessarily the command centre, as there are even larger and, quite possibly contemporary fortified sites in the hinterland (Kiani 1982: 39–61, figs 30–31; see “XVIII. The Strength of the Sasanian Army ...” pp. 129–30). Nevertheless, the fort’s unusual size and its location between two vulnerable points, where the wall had to negotiate deep river valleys (Kiani 1982: fig. 1; see “VI. The Eastern Part of the Wall Between Forts 2 and 4” pp. 103–6 and “VII. The Gorgan Wall in its Landscape: Discussion and Conclusions” pp. 107–8), allow for the possibility that the fort’s defences and internal layout reflect a special function rather than being symptomatic for all forts on the wall. There are several architectural features observed in Fort 4 that were not noted at Fort 1 (Nokandeh et al. 2006: 125–29), including:

1. stronger magnetic anomalies at the upper edges of the fort platform suggesting that fired bricks were also used on the three sides of the fort, which do not abut the Great Wall,
2. the anomaly thought to represent a gate or a blocked gate on the enemy side and
3. the barrack blocks.

Further fieldwork is required to test whether 1. and 2. are unique to Fort 4 or, more probably, may have been represented in a proportion or all of the forts. There may, however, already be sufficient evidence to explore possible parallels for feature 3. Fort 1, for example, seems to have some features in common with Fort 4: the central road and the postulated gate at the side opposite the Great Wall. There are also traces of linear anomalies parallel to the road, two in the west and at least one in the east, whose position suggests that they might represent the central walls of barrack blocks; faint traces of possible rows of rooms on either side of the easternmost linear anomaly may offer support for this hypothesis (Nokandeh *et al.* 2006: 126 fig. 3). While the tentative extrapolation of the existence and location of barracks in Fort 1, from patterns observed in Fort 4, is far from proven, it might be hazardous to read too much into the discrepancy between Forts 1 and 4 in quality and quantity of evidence for buildings. The quality of the survey of Fort 1 was lower than that of Fort 4, partially because Fort 1 (unlike Fort 4) has been ploughed recently (all the more so, as the orientation of modern plough lines in Fort 1, like any potential buildings, are parallel or at a right-angle to the fort's sides). The quality was also partially lower for technical reasons (e.g. the instrument being held closer to the ground in Fort 4 after the systematic removal of obstructive vegetation). This could conceivably account for the non-discovery of possible structures in Fort 1. The buildings in Fort 4 caused anomalies of only approximately 2.5 nT above the background level, suggesting that if the magnetometer had been held higher from the ground their signal would not have been detected.

Yet, even if the possible indications for the presence of barracks in Fort 1 are dismissed as being too uncertain, satellite images demonstrate that Fort 4 was not unique amongst the wall forts in having been filled with barrack blocks. The Google Earth and Corona images of Fort 15 (Fig. 2) shows four distinct parallel north-south orientated long mounds, two each on either side of the central road, filling most of the interior. Kiani's accurate maps based on his aerial photographs

(Kiani 1982: figs 1–7 *passim*) appear to feature north-south-orientated strips in the interior of a range of forts, which may well represent earth mounds formed by collapsed barrack blocks. This suggests that many, if not all, forts had such barrack blocks in the interior. It seems likely that all larger forts on the Gorgan Wall were provided with barrack blocks, possibly four each. Obviously, as the forts differed in their dimensions, so would the barracks. The number of soldiers in a larger fort is likely to have exceeded that in a smaller fort, even the number of barracks or other long buildings may have been the same. The evidence available to date suggests that a series of forts on the Gorgan Wall were densely filled with barracks. The absence of clear traces of long mounds or barracks in some forts is more likely the result of their remains near the surface having been levelled and destroyed by the plough—rather than of a random selection of forts having been left empty. Nonetheless, on the Corona images, a high proportion of forts (including Fort 1) show clear traces of parallel long mounds, likely to represent barrack blocks.

XIII. TOPOGRAPHICAL SURVEY OF FORT 4 AND ITS PROJECTING TOWERS (HO, EWS, EST, JJ & SG)

Whilst scarcely visible on the magnetometer survey (Fig. 21), it seems probable that Fort 4 was provided with a series of projecting towers. That the remains of such towers do not form strong magnetic anomalies is unsurprising: heavy erosion at the edge of the fort or brick robbing will have severely damaged or removed their foundations, not to mention that the uneven ground made survey near the platform edge difficult or impossible. On the SW, SE and NE sides of the upper edge of the fort platform small hillocks are visible, where the sloping sides of the fort bulges out, as first observed by Julian Jansen Van Rensburg and Seren Griffiths. On the NE and SW sides the hillocks are roughly 31 to 32 m. apart. Distances on the SE side seem to be identical, except that the SE gate seems to be flanked by two such features at about half the distance. There is little doubt that these hillocks represent eroded towers. Their slight elevation may have been thrown into relief as a result of human and animal traffic bypassing these obstacles, thus accelerating erosion on either side of them. We counted eight such hillocks on the SE side (including the two flanking the gate and one each at the south and east corners) and nine each on the SW and NE side (again including the ones at the south and east

corners), i.e. 24 in total. We did not observe any traces of towers on the NW side of the fort abutting the Great Wall, but the systematic robbing of the fired bricks makes it impossible to decide (short of excavation) whether this is the result of their absence or systematic demolition.

The topographical survey at Fort 4 (Fig. 24), carried out on behalf of the Gorgan Wall Base (ICHTO), impressively confirmed the observations made on the ground, even if an eroded hillock on the SE side is less clear. There is a suggestion that there might have been ten, rather than nine, projecting towers on the NE side. The survey also created a precise record of the dimensions of the fort and the associated ditch system.

A projecting mud-brick tower on the west side of Fort 13 was excavated by Kiani (1982: 19, fig. 1). Such projecting towers are typical for Sasanian forts and town walls (Boucharlat and Lecomte 1987; Huff 1987: 333; Naumann 1977: 34–38; Whitehouse 1972: 68–71), as well as for contemporary late Roman fortifications. While we had not observed towers on Fort 1, the question arises whether such hillocks could not have been removed by ploughing. An inspection of Fort 30 confirmed that this compound was provided with projecting towers as well. On the best-preserved side, i.e. the east side, hillocks were clearly recognisable and their distance to each other was similar to that observed

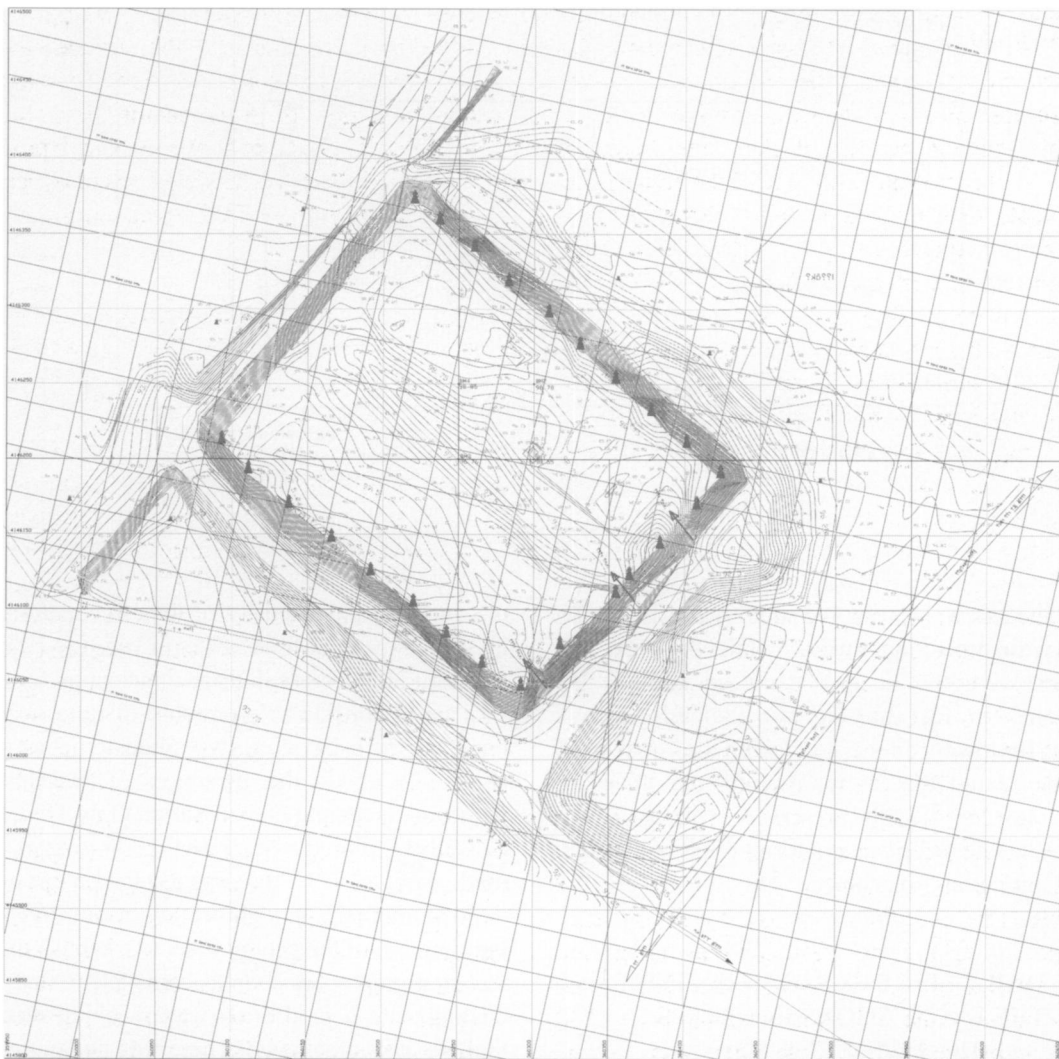


Fig. 24. The topographical survey of Fort 4 on behalf of the Gorgan Wall Base (ICHTO) by Mr Hosseini and Mr Hamidi, checked by Hamid Omrani. The vertical arrow symbols around the edge of the fort platform mark the position of the preserved remains of possible projecting towers. The small grids of 30 × 30 m. are identical to those on Figs 21 and 22; see Fig. 22 for scale and north arrow.

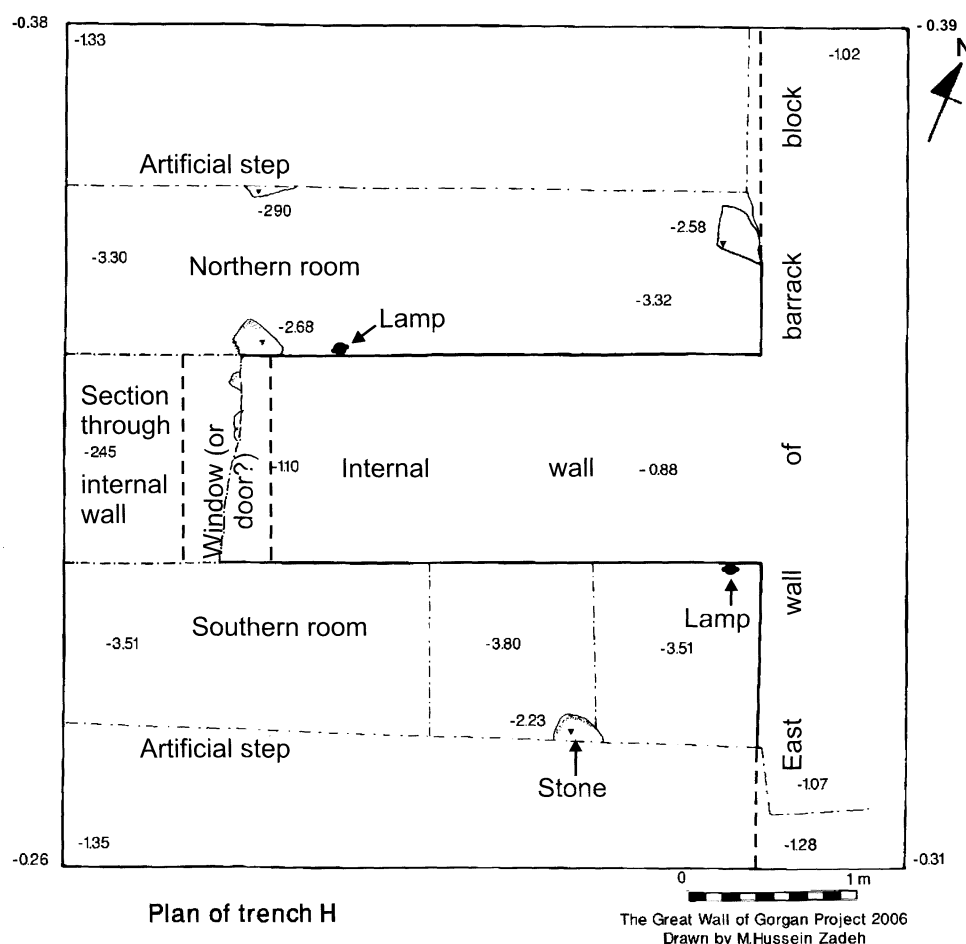


Fig. 25. Plan of Trench H, drawn by Maryam Hussein-Zadeh.

at Fort 4. The less well-preserved south side was equally provided with projecting towers, while the west and north sides were too heavily damaged for detailed observation. No fort has as yet yielded positive indications for towers on the side facing the Great Wall. It is to be feared that at many forts the traces of projecting towers, if still preserved, will disappear before they can be recorded, as a result of ploughing and the use of agricultural machinery.

XIV. DAILY LIFE IN A SASANIAN FORT: THE EXCAVATIONS IN FORT 4 (HO, EWS, EST & SG)

While the magnetometer survey provided us with a detailed plan of substantial buildings within Fort 4, only excavation had the potential to establish their function,

the duration and intensity of their occupation, whether they were made of fired bricks or sun-dried mud-bricks, and their architecture in three dimensions.

Due to considerable pressure of time, we confined ourselves to excavating two small trenches (H and J) (Fig. 22) under the direction of Hamid Omrani, Eberhard Sauer and Esmail Safari. Only Trench H could be fully explored within the 2006 season. We first marked out a 1×3.5 m.-large test trench through a well-defined anomaly, thought to be a room division of the building NE of the central road, to establish the depth of the stratigraphy. It soon became clear that we were dealing with a mud-brick wall reaching much deeper than we had anticipated. There was not enough time to excavate an entire room, but as the trench (H) had to be extended for reasons of safety and to allow us to understand the wider context, we enlarged it to 5×5 m. at the top, and it covered an area of c. 4.10×3.25 m. at

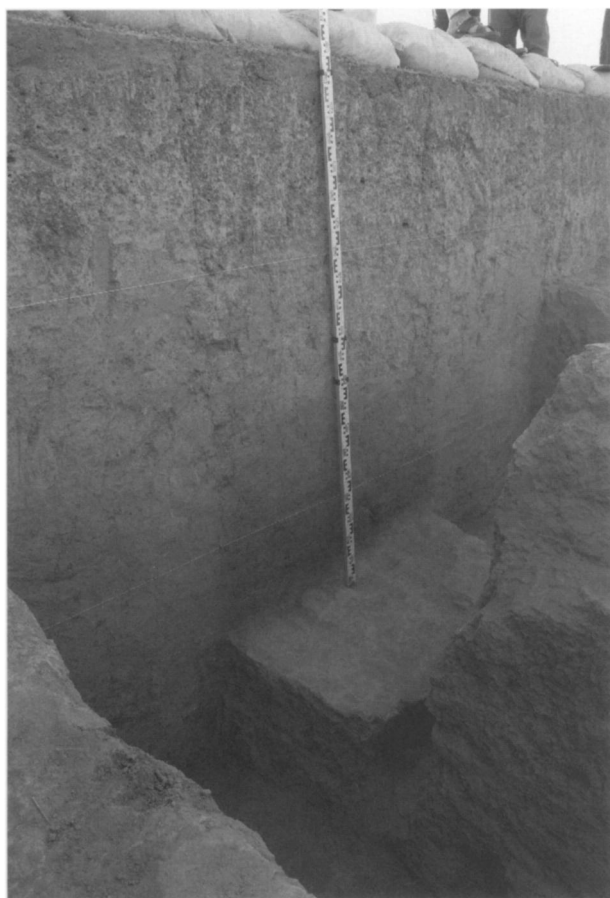


Fig. 26. East-facing section of Trench H, showing clearly the 1.20 m.-wide mud-brick wall.

the bottom. Trench H thus encompassed most of the division wall of two adjacent rooms, a smaller part of the interior of both rooms and a part of the eastern wall of the building (Fig. 25).

The room division consisted of a substantial 1.20 m. wide mud-brick wall (corresponding approximately to the diameter of three bricks). In section (Fig. 26) it was visible as a vertical band of slightly darker colour (greyish-brown clayey silt with lime flecks) than the deposits which had built up on either side of it, presumably as a result of organic components in the mud-brick; we observed traces of possible straw imprints in the mud-bricks. The discoloration extended right to the modern surface, but no individual bricks were found preserved in the uppermost 1.50 m., probably due to natural processes, such as insect and root activity; in fact some plant roots were found in over 2 m. depth and sometimes they grew in the joints between mud-bricks. The colour difference to the deposits which had built up on either side of the wall in the east-facing profile (Fig.

26) was almost imperceptible for the uppermost 0.50–0.56 m., but was distinct at deeper levels. The impression that the preserved wall extends right to the modern surface is, however, confirmed by two crack lines which formed when the soil dried out, and ran in direct alignment with either side of the wall (Fig. 26). In contrast to the lack of evidence for any surviving brick surfaces at a higher level, the bottom courses, notably in the north-east corner of the southern room, were well preserved (Figs 27–30).

Between the rooms we found one arched window (or door?) opening (Fig. 27), first observed by Esmail Safari, which could not be fully explored for safety reasons, because of the substantial weight of the overhanging wall. We are thus unsure whether the stones (Fig. 27) mark the bottom of a c. 0.40 m. high window or whether it was an up to 1.40 m. high doorway, blocked later. During the latest phase of occupation (see below), all of this would have been below ground. The initial connection of the two rooms (whether passable for a person or not) would have facilitated communication between the rooms. Practical advantages in passing messages or goods from one room to another may have been the sole reason for the door or window. It is, however, also conceivable that it might have been intended as a control mechanism, so as to make it more difficult for ordinary soldiers to secretly discuss any grievances with each other.

Above c. 1.50 m. of occupation layers (c. 3.54–2.07 below the benchmark, to be discussed below), a collapse layer was observed (to 1.50 m. below the benchmark), followed by slower sedimentation of windblown particles, as observed by Tony Wilkinson. The depth of the collapse layer and the observation that all buildings detected by magnetometer survey form elongated mounds, as first observed by Roger Ainslie (the two central ones separated by the central road, now a deep hollow way), made us wonder whether we were dealing with single-storey or double-storey constructions. The foundation of the lowest course of bricks was found at 3.60 m. below the benchmark. The bottom of the wall foundations and the modern surface, outside the ditch surrounding Fort 4, are on average at about the same height above sea-level (i.e. c. 95 OD). This suggests that they were erected at ground level. The barracks were not standing on a purpose-built fort platform, but what appears as a platform today (Figs 24 and 31) is mainly the result of the collapse of these mud-brick buildings and the defences and the build-up of deposits within them before. The observation that the collapse of the

Fig. 27. North face of the internal west-east wall with preserved mud-bricks and partially excavated arched window (or door?), drawn by Maryam Hussein-Zadeh.

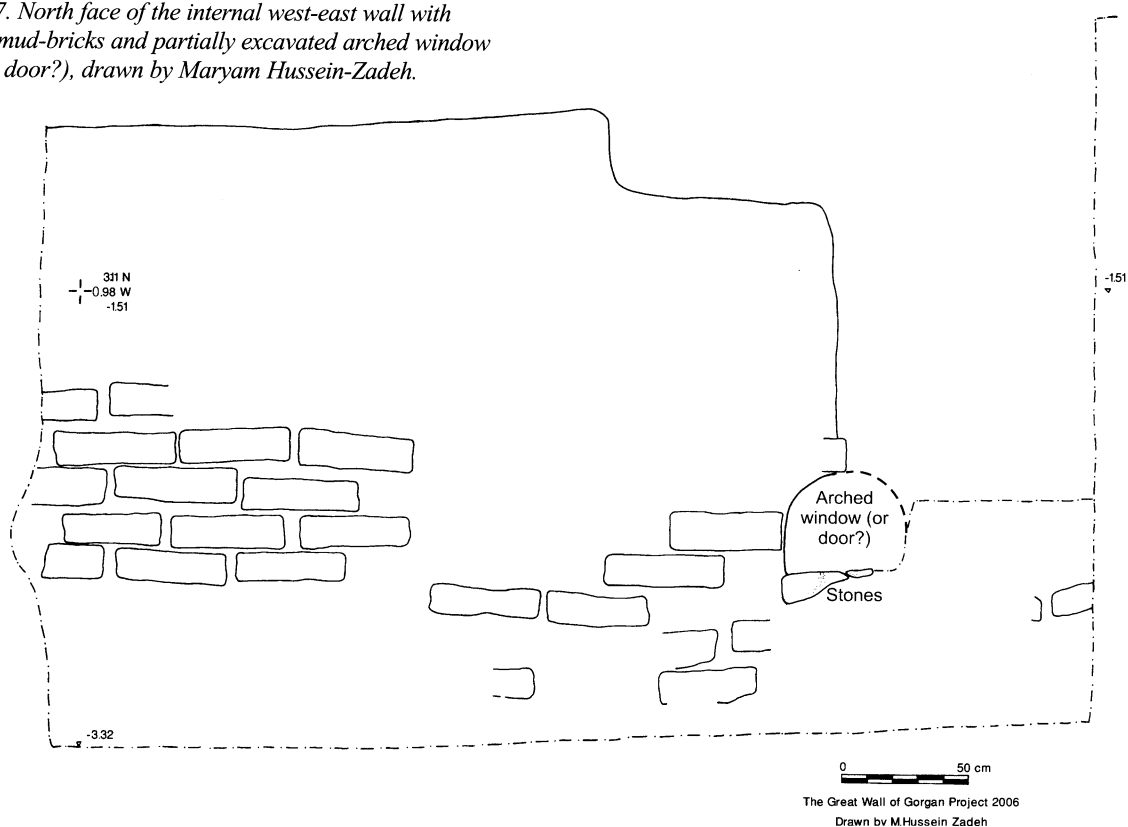
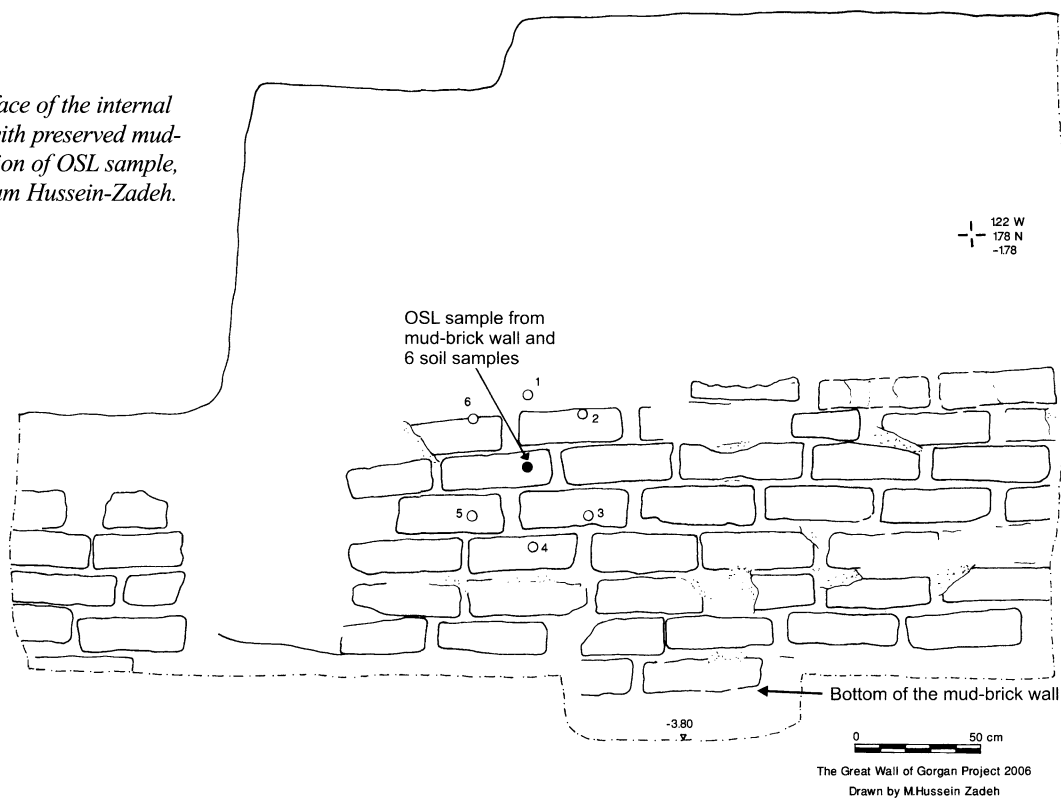
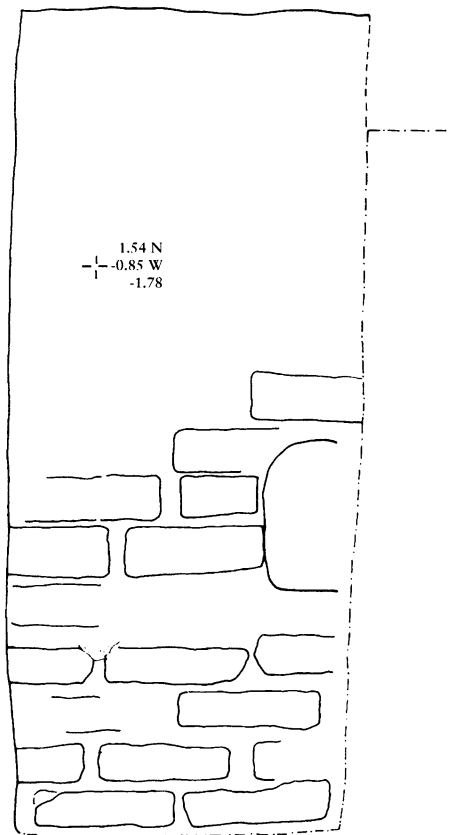


Fig. 28. South face of the internal west-east wall with preserved mud-bricks and location of OSL sample, drawn by Maryam Hussein-Zadeh.





0 50 cm
The Great Wall of Gorgan Project 2006
Drawn by M.Hussein Zadeh

building appears to have raised the ground significantly in the area of Trench H suggests that it was a very substantial building, unlikely to have been only a single storey high. A potential second storey could have doubled the available floor space, thus having significant ramifications for the building's capacity to store food-stuff and to accommodate soldiers and possible non-combatant family members. Two-storey barracks, or barracks with a stairway leading to a second storey or a roof terrace, are also known from late Roman forts (Poulter 2006: 36, 41; Groot *et al.* 2006: 182, fig. 5.1).

The lowest artefact (in both cases a piece of pottery) was found at 3.54 m. below the benchmark in the southern room and 3.18 m. in the northern. In both rooms artefact loss or deposition appears to continue until a floor level of *c.* 2.07/2.06 m. is reached. At levels above this, artefact concentration is much reduced. It thus appears that occupation deposits reached a depth of at least 1.47 m, suggesting a longer occupation of the fort (whether continuous or discontinuous) and, possibly, a longer period when the Great Wall of Gorgan was maintained as a military barrier. The occupation of parts of two rooms need not, of course, reflect the history of all rooms, all buildings and all forts. It seems

Fig. 29. West face of the eastern north-south wall of the barrack blocks with preserved mud-bricks in the southern room, drawn by Maryam Hussein-Zadeh.



Fig. 30. The north-east corner of the southern room with preserved mud-bricks.



Fig. 31. Fort 4 (like the other forts on the Gorgan Wall) forms a substantial platform, here the small side seen from the south-east. Note the human scales (between the cows) in close vicinity to the fort.

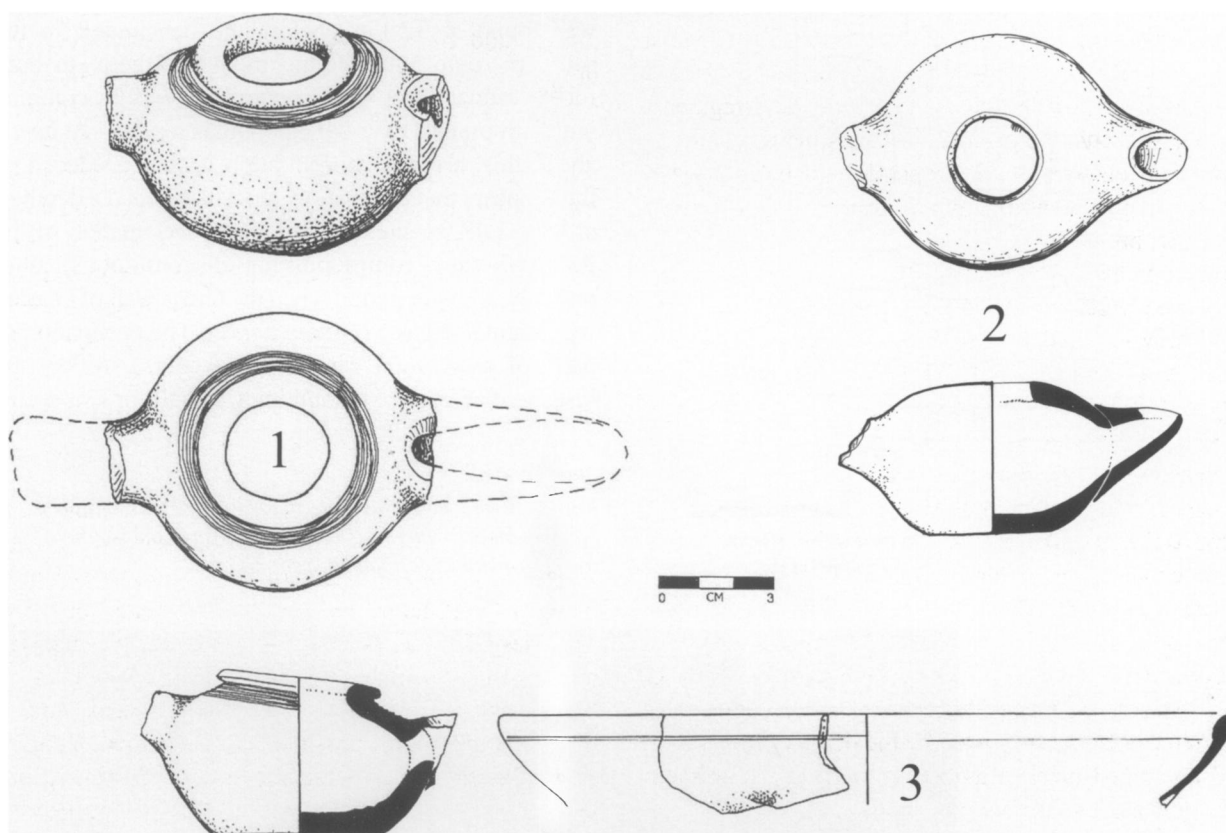


Fig. 32: 1. Lamp found in the southern room; 2. Lamp found in the northern room;
3. Fragment of a glass vessel (H.006), drawn by Mohaddeseh Mansouri Razi.

nonetheless improbable that two rooms selected at random would reveal an entirely atypical occupation pattern, since an adequate number of soldiers had to be maintained on all sections of the wall as long as the system was meant to function effectively as a defensive barrier.

The relative abundance of pottery, which we hope to study in more detail during the next season, suggests strongly that the rooms in question were used from the start as accommodation and not, for example,

exclusively as stables. Needless to say we should not exclude the possibility that other rooms in the same or one of the other buildings may have served as stables or store rooms, but it is equally possible that all rooms housed soldiers, with or without their families.

Interestingly, one lamp each was found in either room, both a similar level (3.23 m. below the benchmark in the southern room and 3.14 m. below in the northern), each immediately next to the wall (Figs 25 and 32.1–2), perhaps as a result of each having dropped off some

TABLE 1. Radiocarbon dates from occupation levels in the northern room in Trench H.³

Small find no.	No.	Material	Depth below BM	Uncalibrated date	Calibrated date (95.4% probability)
H.061	OxA-17015	Bone	-2.13	1468±27 BP	A.D. 550–644
H.020	OxA-17014	Bone	-2.67	1501±26 BP	A.D. 444–636
H.027	OxA-17011	Charcoal (willow or poplar)	-2.70	1489±29 BP	A.D. 471–644
H.096	OxA-17012	Charcoal (alder)	-2.96	1399±27 BP	A.D. 604–66

narrow ledge. The lamp from the northern room apparently had broken *in situ*, its fragmented nozzle, with wick-hole, still being attached to the lamp when found. While we still await the results of scientific analysis of the possible traces of the lamp fuel, fragments of charcoal from the occupation layers indicate that the fort occupants used beech (or possibly plane), alder and willow or poplar as fire wood (see “XIX.2. *Charcoal Analysis*” pp. 132–3), shedding light on the types of trees growing in the surroundings at the time.

Bones were only found from 2.91 m. upwards in the southern room and 2.87 m. in the northern, suggesting that the rooms were, initially at least, kept reasonably tidy and that no food waste was allowed to accumulate. There is no evidence for much organic matter having been allowed to rot *in situ*. Much of the occupation levels consist of re-deposited loess, perhaps representing one or more re-flooring(s) to raise the ground. The lack of rotted organic matter, except for the odd charcoal fleck, made it impossible to visually differentiate between different occupation levels. That there is at least a second one is suggested by a partially preserved red storage vessel (H.025) with organic residue from its bottom, apparently interred *in situ* (as suggested by the perfect preservation and horizontal level of its bottom part) at the northern edge of the southern room. Its inner bottom was 2.31 m. below the benchmark and its highest preserved part 2.07 m. The latter figure, similar to the level where finds peter out in either room (and notably the southern room), may indicate the approximate level of the floor surface during the last phase of the room’s occupation. Storage vessels have also been found interred at ground floor level in the fifth-/sixth-century two-storey barrack blocks of Dichin in Roman Moesia/ Bulgaria (Poulter 2006: 36, 41).

A sequence of radiocarbon dates from occupation levels in the northern room (Table 1) suggests that it was occupied until at least A.D. 604. A bone from near the top (H.061) has yielded a probable *terminus ante quem* of A.D. 644 for the formation of the highest occupation deposits. We cannot, of course, exclude the possibility

that one or more of the samples represent organic matter re-deposited long after the relevant organism’s end of life and should await further scientific dates from the uppermost occupation layers before postulating a specific date for the abandonment of the room with absolute confidence. One is nevertheless inclined to think that the absence of any positive evidence of activity beyond the mid-seventh century amongst the samples is unlikely to be coincidental. Possible historical contexts for a potential abandonment between A.D. 604 and 644 are provided by the major wars the Sasanian Empire fought against the Byzantine Empire from A.D. 603–28 and against the Arabs from A.D. 636 onwards.

By contrast, the best parallels for one rim sherd of a glass vessel (H.006: Fig. 32.3) 2.40 m. below the benchmark from the adjacent southern room (i.e. at a lower level than that of the storage vessel from the same room—and also lower than the bone sample of A.D. 550/604–44 from the northern room), are, according to Birgitta Hoffmann, as late as the ninth or tenth centuries.⁴ This raises intriguing questions: was the wall maintained as a military barrier much longer than we thought, or were perhaps some of the forts transformed into villages? Are the possible traces of settlement SE of Fort 4 Sasanian or early Islamic or both? Of course, one should not base the chronology of the later occupation of Fort 4, let alone other forts, on the typological dating of a single find from a single room. An attribution of the piece to the Sasanian period should not be excluded; indeed, while more research is desirable, unpublished local parallels may well point to a Sasanian date. Unless in future other finds or scientific dates should corroborate late occupation, it seems more plausible to assume that the rooms ceased to be occupied in the first half of the seventh century.

We also found a yellow glass bead of 5 mm. diameter (H.055) 3.27 m. below the benchmark and just one object of copper alloy, a square plaque with rounded edges of 9 mm. diameter (H.092) 3.46 m. below the benchmark; these three objects came all from the

southern room. To what extent the scarcity of metal objects amongst the finds reflects a real shortage of metal, mud-brick architecture, for example, not requiring iron nails, and to what extent the potential predominant use of larger items not easily lost or left behind, is hard to decide. We do not know whether or not the garrison comprised heavily armed soldiers, as the typical helmets or coats of mail that would identify such soldiers (cf. Overlaet 1993) would not have easily been lost or left behind or broken into recognisable parts. While our sample is too small for definite conclusions, the comparative infrequency of metal finds has also been observed at Sasanian Merv (Simpson 2004: 235).

A second trench (J) was marked out to encompass the south-western enclosure of the NE complex and some of its interior. Work on the trench was not completed in the 2006 season and we hope to do this in 2007. Only a brief interim survey will therefore be offered here. To our surprise, no feature was found in the alignment of the south-western side of a large rectangular anomaly, thought to be an enclosure. It seems improbable that magnetometer survey would have picked up a deeply buried ditch. The bricks of substantial mud-brick walls in Trench H only showed up clearly at a deep level (and the wall itself only became apparent as a soil discoloration, once the soil had dried out for several days); thus it seems possible that there was a mud-brick wall, not recognised during our short season. Full excavation of the trench will hopefully yield an answer. Until such results are available we have to rely on the magnetometer survey and observations on the ground, which suggest that the fourth complex contained a long building as well (see “XII. *The Buildings in a Sasanian Fort*” pp. 113–8).

XV. MAGNETOMETER SURVEY OF THE EXTRAMURAL AREA OF FORT 4 (EWS, HO, RA, EST, TW, ME, SG & AN)

Whether or not there were contemporary undefended settlements outside the forts is essential for assessing the security situation on the Great Wall and any potential economic function of the wall forts. Did Fort 4, like many of its early Roman (though less often its contemporary late Roman [Crow 2004: 109; Southern and Dixon 1996: 136]) counterparts attract camp followers, e.g. merchants, not to mention the soldiers’ families? If so, were the soldiers’ wives and children permitted to live within the fort or did they have to stay outside?

The magnetometer survey by Abingdon Archaeological Geophysics and the ICHTO (Fig. 21), prominently displays recent plough lines, but yielded no evidence for any extramural settlement. This, however, proves merely that there are probably no remains of substantial structures, made of materials of different magnetic properties to the subsoil. A pottery scatter around the fort, notably on its SE side together with associated mounding typical for settlement sites, might derive from a settlement outside the defended perimeter. The SE side was, of course, the point where the road led out of the fort and thus was the most obvious area for settlement. Lightly-built structures would probably not be detectable and even less so on recently ploughed fields. Without extensive excavations in the extramural areas it may not be possible to prove the presence of settlement outside the defended perimeter. Should future fieldwork fail to find traces, it may nevertheless be impossible to disprove the existence of extramural settlement, as we always have to allow for the possible presence of untraceable yurts (Stronach 2004) or mud-brick buildings destroyed by ploughing. Fortified Sasanian sites in the Mughan Steppe in north-west Iran, some of them with a partially rectangular shape similar to the Gorgan Wall forts and supplied with water by canals, have all yielded evidence for extensive extramural settlement (Alizadeh and Ur 2007: 152–54).

Despite the inconclusive results, a few more general considerations on the use of extramural areas may not be out of place. It is perfectly conceivable that family members were admitted into the safety of the defended compounds, rather than soldiers living in the barracks on their own. That the small finds assemblage from Trench H does not allow us to prove or disprove the presence of women and children is unsurprising. How difficult it is to establish whether they were present or absent with any degree of certainty is best demonstrated by the fact that, despite extensive fieldwork in numerous Roman forts and fortresses and some work on distribution of “gendered” artefacts (Allison *et al.* 2005; cf. Groot *et al.* 2006: 161), notably a sizeable number of women’s and children’s shoes in barrack blocks at Vindolanda (Driel-Murray 1997), opinion remains divided between those who argue for the frequent presence of partners and children of rank and file soldiers (James 2001: 80, 83–85; Nünnerich-Asmus 2006), and those who argue that only the officers’ wives would normally have lived within the defended compounds (Crow 2004: 81–82, 104, 109; Debrunner Hall 1994: 221; Sommer 1984: 30–31, 52; Speidel 1997). One is inclined to think there

is an increased probability of their intramural presence in forts without contemporary settlement outside (cf. Southern and Dixon 1996: 85, 136).

Not a single coin has as yet been found at any of the Wall forts, suggesting that, contrary to modern views and possibly other units elsewhere (Puschnigg 2006: 21–22), the soldiers were not paid in hard currency and did not normally participate in a monetary economy. This might add credence to the fourth-century historian Ammianus Marcellinus's (23.6.83) claim that the Persian infantry received neither pay nor gifts. Of course, such a generalised statement by a historian, whose work pre-dates the construction of the Gorgan Wall, should not imply that the soldiers serving there necessarily consisted mainly or exclusively of infantry. The absence of coinage implies nonetheless that they probably received remuneration in kind. There is nothing in the layout of the forts to suggest that they were involved in farming. While they are still likely to have participated in goods exchange with traders or craftsmen providing specialised goods or services, we do not know whether the latter settled next to the fort.

XVI. SASANIAN FORT DESIGN (EWS & HO)

The phenomenon of forts being occupied exclusively or almost exclusively by barracks or other elongated structures is not unique to the Great Wall of Gorgan. Three forts in Upper Mesopotamia, Ain Sinu I (Oates 2005: 81–92; Kennedy and Riley 1990: 168–69, 213–15), Tell Bâti (Poidebard 1934: 150, pl. CXXXIX) and a fort at Saibakh, 3.5 km. from Tell Brak (Poidebard 1934: 144, pl. CXXII; Oates and Oates 1990: 229–30), share key features with Forts 4 and 15 on the Gorgan Wall (and probably the other forts on the wall):

- All their built-up interior space appears to be taken up by such parallel buildings, consisting of mud-brick walls (which, after their collapse, have formed long mounds).
- All have square corners.
- At least some seem to form distinct platforms now.

Kennedy and Riley (1990: 213–15) have appropriately called them “Barracks Forts”. Ain Sinu is in an area held by Rome temporarily in the late second and in the third century. Tell Bâti and Saibakh are in the immediate frontier zone between the Roman Empire and the

territories ceded by Rome to Sasanian Persia in the peace treaty of A.D. 363. The information provided by the ancient sources is insufficiently precise to tell whether they were within Sasanian or Roman territory after A.D. 363 (Ammianus Marcellinus 25.7.9; Zosimos 3.31.1; Boeft *et al.* 2005: 233–39). With the possible exception of Tell Bâti and Saibakh, whose location in the frontier zone neither excludes an attribution to the Persian nor to the Roman Empire, there are, to our knowledge, no exact parallels within the Roman Empire in its post-A.D. 363 boundaries. Since Tell Bâti and the fort at Saibakh have never been excavated, the latter now being buried under a modern village and the former “completely defaced” (Oates and Oates 1990: 229–30), their date and the cultural association of any artefacts cannot easily be verified. Oates (2005: 85, 145; cf. Oates and Oates 1990: 230) postulated a Roman origin for Ain Sinu I and a date between the Severan campaigns of the late A.D. 190s and Ardashir's invasion of Mesopotamia in c. A.D. 237. While the occupation debris in the barracks and gate-chambers were only a few centimetres thick and “almost barren of objects”, sherds similar to wares from Hatra of the first half of the third century A.D. were found on the floor and embedded in the walls (Oates 2005: 85). Oates (2005: 85) cited two coins, minted in A.D. 218/222 and A.D. 222/235 “found inside the camp in debris just above the floor or ground level” as further support for an occupation period within the postulated parameters.

St John Simpson (1996: 90–92) was the first to challenge this dating proposal and to argue that the “Barracks Forts” need not be Roman, but could be Sasanian. He rightly stressed that the postulated third-century dating rested mainly on residual and unstratified material and argued that a reoccupation under Sasanian rule was highly probable. The sherds “embedded in the mud-brick” (Oates 2005: 85) must indeed be “residual sherds re-used in the construction” as Simpson (1996: 92) observes; had the barracks been built at a virgin site, then few, if any, sherds should have found their way into the mud-brick. Should Oates nevertheless be correct in assigning the barracks of Ain Sinu I to the third century (even if hardly immediately after the Severan conquest), then it is still impossible to tell whether we are dealing with short-lived Roman or early Sasanian barracks; pottery chronology does not permit us to tell whether the small assemblage pre-dates or post-dates Ardashir's invasion and temporary conquest of the area. As the excavation report does not reveal which precise sherds were found in the occupation layers “almost barren of objects”, there is no certain way of establishing whether

the Ain Sinu I barracks date to a few decades or a possibly a few centuries after the establishment of the earliest compound at the site. Simpson's preference for a later date may be further strengthened by Ain Sinu I and Fort 4 on the Gorgan Wall, in addition to the common features of the "Barracks Forts" listed, sharing two other characteristics:

- The shape and size ($43 \times 43 \times 9$ cm.) of the square mud-bricks, used for the barracks and outer wall at Ain Sinu I (Oates 2005: 84), are remarkably similar to those used for the Fort 4 barracks and the fired brick from the Great Wall of Gorgan.
- Some of the Ain Sinu I barracks were located within a walled courtyard (Oates 2005: 83–84 with fig. 6) and the geophysical survey may suggest that the SW barrack in Fort 4, as well as the unidentified NE complex, were within similar enclosures (Figs 21–22).

Unfortunately, there is not enough evidence to decide whether all three "Barracks Forts" in Upper Mesopotamia are Sasanian, whether they are all Roman or whether both empires built this type of fort in a fought-over contact zone. Neither can we be certain whether the "Barracks Forts" all date to Late Antiquity or whether some are earlier. What is beyond doubt now, however, is that the Sasanians (exclusively or non-exclusively) constructed this type of military installation in the fifth and/or sixth century A.D.. It is worth noting here that, while there are no exact parallels further afield in the Roman world, there are also late Roman installations, such as Cologne-Deutz (Precht 1975; cf. Southern and Dixon 1996: 141), with square corners and no buildings others than barracks in the interior. Why there were no recognisable administrative buildings or more lavish accommodation for the higher ranks has to remain a matter of speculation. Of course, some of the control centres and administrative installations could have been located in the larger and as yet unexplored hinterland fortresses (see "XVIII. The Strength of the Sasanian Army ..." pp. 129–31). Confining building in forts to basic accommodation certainly helped to keep the perimeter to be defended small. The exclusive use of the same type of standardised building would also have accelerated construction works. Avoiding unnecessary architectural complexity probably reflected a military strategy conscious of the fact that speed could make the difference between success and failure. Architectural uniformity need not

imply a lack of functional versatility. If, for example, each group of soldiers occupying a room (or two rooms in a double-storey building?) kept their proportion of food supplies within their living quarters, then there was no need for central granaries.

XVII. THE SIZE AND NATURE OF THE GARRISON OF FORT 4 (EWS & HO)

The evidence, through magnetometer survey, that Fort 4 contained three buildings with an estimated 90–96 rooms each, not counting the fourth complex, eradicates any doubt that the fort was densely occupied. It is likely that most, if not all, the rooms in these three virtually identical buildings served as human accommodation as proven for the two rooms explored in Trench H. In early Roman barrack blocks each unit consisting of a double room (the front room for storage and the back room for living) formed a *contubernium* (i.e. a sub-unit sharing a tent on campaign) of eight soldiers (Johnson, A. 1983: 166–67, 171–76). In Late Antiquity, this type of double room was reduced to a single unit, with or without subdivisions, but these single units were not necessarily smaller than the earlier double-rooms (e.g. Crow 2004: 100–4). The substantial variations in size amongst both early imperial (Johnson, A. 1983: 166–76; Petrikovits 1975: 36–43) and late imperial barrack rooms (Johnson, S. 1983; Gregory 1996; Groot *et al.* 2006) make it impossible to give a typical size, but it is fair to say that the Sasanian single rooms in Fort 4 (roughly 5×7 m.) were perfectly within the range of their late Roman single-room and even their early or high imperial double-room counterparts. It thus seems reasonable to assume that they provided shelter for a similar number of occupants, i.e. up to eight soldiers.

The Late Antique Roman legionary fortress at El-Lejjun east of the Dead Sea in modern Jordan contained barracks with a minimum of 256 rooms in the early and mid-fourth century A.D. and was slightly smaller: 4.6 ha. as opposed to Fort 4's 5.5 ha. Estimates for its garrison vary between 1,000 and 2,000 soldiers (Groot *et al.* 2006: 183; Parker 2000: 134; Southern and Dixon 1996: 31–32), though a figure below 1,000 cannot be excluded (Tomlin 2000). The higher estimate is based on the assumption that there were still eight soldiers per room unit. The above-mentioned "Barracks Fort" Ain Sinu I provides a closer parallel to Fort 4. If Oates's reconstruction is correct, there were 528 rooms of unequal size or 220 units of two rooms each and 88 units of one room each (not counting further chambers around the fort

walls). Of these 308 room units Oates (2005: 83 fig. 6, 89–90) assumes that 28 served junior officers and that the remaining 280 were occupied by eight soldiers each, i.e. 2,240 soldiers in total (or still over 1,100 on the, as Oates stresses himself, unproven and highly speculative assumption that half may have served as stables). If we assumed that each individual room in the Ain Sinu I fort was occupied by four soldiers (or double room by eight) on average, then the total number of soldiers would be c. 2,000, if by eight, c. 4,000. If the same average number of soldiers shared a room in both forts, the garrison of Ain Sinu I would have been about twice the size of that of El-Lejjun. In terms of area, Ain Sinu I was, with 10.6 ha. (Kennedy and Riley 1990: 215), roughly twice the size of Fort 4, and both compounds were densely occupied. It is thus possible that Fort 4, being of comparable size and number of rooms to El-Lejjun and about half the size and room number as Ain Sinu I, was designed for 1,000 or 2,000 soldiers (which implies c. four or eight men per room, i.e. a similar occupation density as in Roman barrack blocks).

A comparison with earlier Roman forts in the west adds further strength to the assumption that 1,000–2,000 soldiers may be the right order of magnitude. Fort 4's size (5.5 ha.) corresponds roughly to the average space needed for 1,000 horsemen or 2,000 foot-soldiers in the second or third century A.D., though it ought to be conceded that there are considerable variations in the size of Roman forts for units of similar strength and composition (Johnson, A. 1983: 292–93, cf. 22 tab. 1). Fort 4 is roughly a third to a fifth of the average size of a high imperial legionary fortress for some 5,000–6,000 men, an observation which might offer further support for a garrison of 1,000–2,000 men. Closer in time and layout than legionary fortresses of the principate is the early fourth-century bridgehead fort at Cologne-Deutz, filled exclusively with barrack blocks, 16 in total. (While the reconstruction of the interior is based on the excavation of a series of small trenches, covering just a tiny fraction of the area, the regular size and spacing of inner buildings is indeed best explained with the Deutz being a kind of "Barracks Fort" as well.) Precht (1987: 515) postulates that there may have been a century each in 12 barracks blocks, the four central ones being set aside for the officers and administrative functions, adding up to a total garrison of c. 1,000 men. There is no good reason why Fort 4, whose interior was three times larger than that of Deutz (1.8 ha.)—even if the combined area occupied by its barracks was of a similar order of magnitude to that of the 16 narrowly spaced

barrack blocks of 11.5×57.4 m. each at Deutz (Precht 1975; 1987)—should have had a smaller garrison.

While any figure between 1,000 and 2,000 is possible (and a figure slightly below the minimum or above the maximum estimate not inconceivable), round figures, whether 1,000 or 2,000 men (i.e. roughly four or eight per room, leaving a few rooms for other functions), may be easier to reconcile with the little we know about the organisation of the Sasanian army. One thousand men would correspond to the postulated size of a Sasanian unit called *gund*, and there is in any case circumstantial evidence to suggest that the organisation of the Sasanian army was based on units of 1,000 men and multiples thereof (Widengren 1957: 162–63; 1976: 282; Huyse 1999: 133–34; cf. Shahbazi 1987: 497–98; Gyselen 2001: 20–22). Admittedly, the postulated division of either one or two units over three barrack blocks seems odd (unless there is a fourth, as yet undetected, barrack block in the NE complex), but it ought to be admitted that we know so little about the organisation of the Sasanian army that any of the above assumptions are speculative.

As the wall was a threat from mounted armies, one wonders whether it would not equally have been defended by cavalry, or at least partially mounted, units. If so, the question where the horses would have been kept (e.g. in some of the rooms of the three barrack blocks or in the fourth compound or outdoors) is as yet unresolved. Research on Roman forts has demonstrated that horses were often kept in the same room units as horsemen and that the absence of separate stables by no means disproves the presence of substantial numbers of horses within a defended compound (Hodgson 2002). A single equid bone from the small assemblage from the Sasanian-period ditch fill at Fort 9 (see "*XIX.1 Animal Bones*" pp. 131–2) does not resolve the question, especially since we do not know to what extent this assemblage represents food or butchery waste, as opposed to disposal of the remains of mounts or beasts of burden.

XVIII. THE STRENGTH OF THE SASANIAN ARMY IN THE GORGAN PLAIN (EWS & HO)

Despite many as yet unresolved questions (e.g. the number of storeys per barrack block and the proportion of floor-space reserved for storage or horses, or potentially occupied by civilians), it now seems possible to venture at least rough estimates of the total size of the Sasanian army stationed at this frontier. According to

Kiani (1982: 15 fig. 9), who slightly overestimates the size of the two forts we have surveyed so far, the combined size of all 33 forts known to him was 15.7 times that of Fort 4 alone. If all forts were as densely occupied as Fort 4, and if Fort 4 housed a garrison of c. 1,000 to 2,000 men (as suggested above), then the total garrison the 33 forts would have been between c. 15,700 and 31,400 soldiers. If we assumed that there were eight soldiers in each room (as often thought to be the case in Roman compounds) and that there were 96 rooms each in the three blocks, the estimate for the garrison of Fort 4 could be raised to 2,304 (or even a third more if there was fourth barrack block in the NE complex) and that for all forts to over 36,000. If, on the other hand we assumed that the forts were occupied as densely as those on Hadrian's Wall (c. 9,500 men in 15 forts totalling 28.7 ha. [Breeze and Dobson 2000: 54, 159–62]), then the garrison on the Gorgan Wall would have been in the order of 30,000 men—assuming the combined size of the forts was approximately 90 ha., as opposed to Kiani's (1982: 15 fig. 9) (over-)estimate of 113.1 ha. Even the lowest of the above estimates for the number of soldiers stationed at one single frontier implies that the Sasanian Empire may well have had one of the strongest and best-organised armies of the ancient world. In order to come to a more reliable estimate, it will be necessary to continue the investigation of the interiors of the wall forts and to establish whether or not Fort 4's density, type and size of internal buildings were typical for the forts on the wall. Circumstantial evidence, notably from aerial photography and satellite imagery (as discussed above), suggests that it probably was.

The estimate for the size of the wall's garrison may, however, be substantially too low, if square fortresses in the hinterland are contemporary, had military garrisons and a similar occupation density. Qaleh Kharabeh, for example, reached a size of 56 ha. (i.e. c. ten times the size of the largest fort on the wall) and the surface pottery suggests that it was occupied in the Parthian and/or Sasanian periods (Kiani 1982: 43, figs 7, 30–31, pls 15,2–16,1). Other square, or almost square, fortresses with Partho-Sasanian pottery include the 25 ha. large Qaleh Gug A (Kiani 1982: 42, figs 30–31, pl. 14,1), Qaleh Yasaqi of similar dimensions (Kiani 1982: 53, figs 30–31, pl. 22,2), Qaleh Daland of 33 ha. size (Kiani 1982: 58–59, figs 30–31, pl. 30,1) and Gabri Qaleh of 42 ha. (Kiani 1982: 56–57, figs 30–31, 39, pls 26,2–27,2, 28). Four further compounds of square or rectangular shape (Kiani 1982: figs 30–31) may conceivably belong to the same system as well, but shall

not be discussed here, as no information on their date could be found. The square plans of the listed fortresses leave little doubt that they were carefully planned installations and that their outer perimeter at least must belong to a single phase. Four of the five compounds include a citadel, invariably located in a corner. Further fieldwork is required to test whether these citadels are contemporary artificial mounds and lookouts, or whether they are ancient *tepes* incorporated into new fortresses. The latter development is likely to account for Qaravol Tappeh being situated in Fort 13 on the Gorgan Wall (Kiani 1982: 43–44, figs 3, 32, pl. 4,3).

The observation that the rectangular installations (excluding rectangular *tepes*), at least as far as included in Kiani's survey (Kiani 1982: 39–61, figs 30–31), all seem to be south of the wall and seem to have been occupied in the Partho-Sasanian period suggests that they may have formed part of the same, defence-in-depth, system. Should this assumption be correct, then the number of Sasanian soldiers stationed in the Gorgan Plain could have been substantially higher than suggested above (even if already the lower estimate, excluding any hinterland garrisons, suggests a remarkably strong army). It would be premature to postulate that these hinterland compounds were necessarily all mono-functional and all contained barrack blocks. Not all need have been occupied mainly or exclusively by military personnel; the polygonal 338 ha. Dasht Qaleh (Kiani 1982: 48–52, figs 30–31, pls 17,2–22,1) has plausibly been interpreted as a city and an explanation as civilian settlements may also be correct for many agglomerations of irregular shape or long-lived *tepes*. The square compounds would, of course, have been more suitable for being filled with rectangular barrack blocks and the military interpretation gains in strength, if the first or only peak in pottery deposition is reached in the Sasanian period.

An aerial photograph of 56 ha.-large Qaleh Kharabeh (Kiani 1982: pl. 15,2, cf. fig. 7) shows the typical "stripy" pattern, four or five parallel stripes in the north-east quadrant being particularly clear; while any interpretation without inspection on the ground has to remain preliminary, it seems possible that these stripes represent a large number of barrack blocks. On the assumption of a similar dense occupation as Fort 4, its garrison could easily have been up to ten times larger (i.e. 10,000–20,000 soldiers, temporarily or permanently, in this one fortress?). This is particularly astonishing as there were no longer any fortresses, anywhere near this size, in the Western and Eastern

Roman Empire in Late Antiquity. Kiani's aerial photographs do not show the same stripes in the other square compounds, but fieldwork will be required to test whether this is due to their original absence or due to modern cultivation in the fertile Gorgan Plain having obliterated any traces on the ground.

Should we be right in thinking that at least some of the square compounds served as fortresses, then we will have to reassess not only the strength of the Sasanian army, but also the military strategy employed in the Gorgan Plain. While there are also smaller installations, notably the Sasanian fort of Tureng Tepe (Boucharlat and Lecomte 1987), several of the forts in the hinterland are substantially larger than those on the wall and are often in a more advantageous strategic location. Thus they are more likely to have contained the command centres. Positioning the strongest military units in the hinterland would make perfect sense and is paralleled by the strategy employed by the Roman army. In case hostile forces threatened any particular section of the Great Wall of Gorgan or had managed to break through, troops in the hinterland could have more easily and rapidly repelled such an attack than would have been possible by assembling troops from other forts on the wall.

More fieldwork will be required to test whether Qaleh Kharabeh indeed was densely filled with barrack blocks and, if so, whether or not this is paralleled in some or all of the other square compounds. Substantial barrack blocks are unlikely to be designed for a temporary garrison, e.g. troops in transit, more likely to be accommodated in tents or yurts. Even the evidence available at present suggests that the Sasanian Empire was able to mobilise substantial manpower and that the permanent garrison in the Gorgan Plain alone numbered many tens of thousands of men. It seems highly likely that an Empire stretching from Mesopotamia into the Indian Subcontinent would have held strong local garrisons not

just on land bordering the Caspian Sea, but also elsewhere. To the local garrisons we must add the field army, thought to have comprised 50,000 men (Widengren 1976: 296–97; Greatrex 1998: 57–58). The 2006 season has yielded fascinating new evidence to suggest that the Sasanian army in the fifth and sixth centuries was substantially stronger, in terms of numbers and organisation, than had previously been thought. Just how little we had known until very recently is exemplified by Greatrex's (1998: 52; cf. Puschnigg 2006: 22) recent doubts as to whether or not the Sasanian Empire had a standing army at all. The barrack blocks and the sheer scale of the military installations in the Gorgan Plain not only eradicate any such doubts, but suggest that the Persian army was an equal to its late Roman counterpart—and in some respects perhaps more than an equal. It would be wrong to ascribe the ability of this major power to maintain and expand its vast Empire primarily to its rivals' (e.g. the Eastern Roman Empire's) weaknesses; the inner strength and dynamism of the Sasanian Empire, facing no fewer external threats along its extensive frontiers (such as those adjoining the Caspian Sea) than any of its rivals, is more crucial for explaining its success.

XIX. APPENDIX

XIX.1. *Animal Bones (RT)*

This report provides an analysis⁵ of the animal bones from ditch fills from Trench B near the north-west corner of Fort 9 of the Gorgan Wall, Iran. These bones all derive from the middle and lower levels of deposit B.006 (Nokandeh *et al.* 2006: 143 fig. 22), sealed well beneath the wall tumble (B.013, B.004 and B.010) and from the lower levels of B.003/005, and are likely to represent rubbish deposition in the dried-up ditch by a later garrison

TABLE 2. Representation of species

	Sasanian	?Sasanian	Late Sasanian/ early medieval	Medieval	Total
Cow (<i>Bos taurus</i>)	4		1		5
Sheep/goat (<i>Ovis/Capra</i>)	14	5	2		21
Sheep (<i>Ovis aries</i>)	1				1
Equid (<i>Equus</i> sp.)	1				1
Unidentifiable	22	12	10	3	47
Total	42	17	13	3	75

of Fort 9. A radiocarbon date of A.D. 433–610 (Nokandeh *et al.* 2006: 161–62) for a sheep mandible from this cluster proves an attribution to the Sasanian period.

In total, twenty-six secure, non-modern, contexts contained seventy-five fragments of hand-collected animal bone, of which only twenty-eight were identifiable to species. The majority of the bones from the site were poorly preserved, exhibiting extensive cortical degradation consistent with acidic and/or sandy free draining soils.⁶ Analysis of the species represented (Table 2), reveals that the identifiable specimens derived from only three domestic taxa, with sheep/goat predominant (79%).

Examination of the body parts represented for Sasanian and probably Sasanian contexts⁷ suggests the inclusion of both primary and secondary butchery waste, with an emphasis on the former—although taphonomic factors could have led to the relative over-representation of teeth and the denser lower limb elements. Two Sasanian sheep mandibles were sufficiently complete to provide an assessment of age and produced ages of 2–3 and 3–4 years. Where the state of fusion could be recorded on post-cranial bones, all but one specimen (the epiphysis of a Sasanian equid metapodial) were found to be fully fused.⁸ No butchery marks or carnivore gnawing was recorded; however, given the poor cortical preservation this is perhaps unsurprising.

Despite the small size of the assemblage, and the poor preservation a clear emphasis on domestic species, particularly sheep/goat is apparent. The animal bones deposited in the ditch fills seem likely to represent activities related to the preparation of animals for consumption. A more detailed examination of the faunal remains from sites located along the Gorgan Wall will fill an important gap in our understanding of the nature of past human-animal interactions in this region, particularly since previous research in this area has largely focused on earlier periods of occupation (see, for example, Bocherens *et al.* 2000; Young 2007; Zeder and Hesse 2000).

XIX.2. Charcoal Analysis (RG)

Charcoal samples from the fill of the kiln in Trench G (see “IX. Excavation of a Brick Kiln” pp. 110–2) and from occupation deposits from Trench H, in the barracks of Fort 4, were submitted for species identification prior to C14 dating. Charcoal was sparse in most of the samples. The charcoal fragments were mostly very small and frequently degraded. The samples were prepared using standard methods (Gale and Cutler 2000). Anatomical structures were examined using incident light on a Nikon Labophot-2 compound

TABLE 3. Charcoal of well stratified samples recovered in 2006

Sample	Context & description	Taxa identified
Trench G		
G.002	G.004: fill of kiln	Too degraded to identify
G.003	G.012: fill of kiln	Insufficient to identify
G.004	G.010: fill of kiln, sample C14-dated	?Chenopodiaceae, narrow stems, very degraded
G.005	G.016: fill of kiln	Insufficient to identify
Trench H		
H.027	H.005, 1.46 m. E, 3.34 m. N, 2.70 m. below BM: occupation layer N room, sample C14-dated	3 × willow (<i>Salix</i> sp.) or poplar (<i>Populus</i> sp.)
H.049	H.005, 3.87 m. E, 3.73 m. N, 2.23 m. below BM: occupation layer N room	4 × beech (<i>Fagus</i> sp.) (or possibly plane, <i>Platanus</i> sp.)
H.096	H.005, 1.47 m. E, 3.28 m. N, 2.96 m. below BM: occupation layer N room, sample C14-dated	6 × alder (<i>Alnus</i> sp.), fast-grown 2 × beech (<i>Fagus</i> sp.) (or possibly plane, <i>Platanus</i> sp.)

microscope at magnifications up to $\times 400$ and matched to prepared reference slides of modern wood. When possible, the maturity of the wood was assessed. Fragments selected for dating were weighed.

The results are presented in Table 3. Beech (*Fagus*) and plane (*Platanus*), although unrelated, are anatomically very similar. While the charcoal from samples H.049 and H.096 is almost certainly beech, it is not possible to rule out plane from the diagnostic data available.

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Notes

- ¹ The OSL dates are not available yet.
- ² OxA-17021, d13C= 1.30: 933 \pm 26 BP, dated by Dr Tom Higham (RLAHA, University of Oxford), using the INTCAL04 marine calibration model with a delta R value set at 0 \pm 50 years.
- ³ OxA-17011, d13C= -27.45 (1.46 m. E, 3.34 m. N of SW corner of Trench H), OxA-17012, d13C= 24.95 (1.47 m. E, 3.28 m. N), OxA-17014, d13C= -11.90 (3.36 m. E, 3.87 m. N) and OxA-17015, d13C= -11.59 (1.86 m. E, 3.58 m. N), dated by Dr Tom Higham (RLAHA, University of Oxford).
- ⁴ *Glass* by Dr Birgitta Hoffmann: This report, on a stratigraphically important piece of glass, is based on the photographic record and a drawing (Fig. 32.3) rather than an inspection of the sherd. The piece was found in the southern room of the barrack block in Trench H at 2.40 m. below the benchmark. It was thus 1.20 m. above the foundations of the internal wall and 1.14 m. higher than the lowest find, but still 0.33 m. lower than a storage vessel *in situ*. It provides a *terminus post quem* for a late (but not the latest) phase of occupation

While superficially similar to the bowls from Tell Madraseh pit X13 or W21 (Nishapur), the piece has a very clearly inturned collar-rim, while the ninth/tenth century pieces from Nishapur (modern Neyshabur) have out-turned rims (Kröger 1995: 44–45). Similarly, the in-turned rims of the sixth century do not agree with the suggested vessel

shape, which is flat and ovoid, but probably from a bowl or deep dish. In-turned rims like the one shown on the photographs appear to be comparatively rare on bowls or deep dishes and the closest parallels I can find are from Qa'alat Semaan in Syria (Dussart 2003: 172 fig. 3.1–1c), which are dated to the Abbasid period with further parallels cited from the Island of Bijan. This would thus suggest a date in the ninth–twelfth, but most likely ninth–tenth centuries.

⁵ In light of the small size of the assemblage an attempt was made to identify all fragments. The zoning system of Dobney and Reilly (1988) was adopted, and all butchery marks were recorded following Lauwerier (1988). Measurements were taken using the methods outlined by von den Driesch (1976). The tooth wear stages of Grant (1982) were used for the recording of cattle and Payne (1973; 1987) for sheep/goat. The preservation of the bone was recorded using a four-point scale (following Harland *et al.* 2003):

1. Majority of surface fresh or even slightly glossy; very localised or powdery patches;
2. Bone surface lacks fresh appearance but solid; very localised flaky or powdery patches;
3. Surface solid in places, but flaky or powdery on up to 49% of specimen;
4. Surface flaky or powdery over 50% of specimen. (RT)

⁶ TABLE 4. Preservation of post-cranial elements (after Harland *et al.* 2003)

Score	NISP
1	0
2	2
3	7
4	5

Such taphonomic conditions account for the abundance of teeth within the assemblage (48%), since these have a higher density than post-cranial bones, and it is to be expected that anatomical zones of lower density and the unfused bones from young animals are under-represented in this assemblage due to post-depositional degradation. (RT)

⁷ TABLE 5. Representation of skeletal elements (RT)

	Cow	Sheep/goat	Horse
Cranium (skull, mandible and teeth)		17	
Vertebrae	1		
Forelimbs (scapula, humerus, radius)		1	
Pelvis	1		
Hindlimbs (Femur, tibia)			
Lower limb (Metapodials, carpals, tarsals, phalanges)	2	2	1

One pathological bone was recorded: a cow caudal vertebra from a late Sasanian/early medieval context, at the interface between B.006 and the wall tumble (B.004), which exhibited two cavities in the cranial epiphyseal plate with associated pitting. These lesions are probably the result of intervertebral disk degeneration and the subsequent herniation and penetration of the nucleus pulposa (a jelly-like mass in the centre of the intervertebral disk) into the epiphyseal plate. Such changes typically occur as part of the normal process of ageing, and thus provide indirect evidence for the keeping of old animals.

⁸ TABLE 6. Post-cranial bones (all measurements are in tenths of millimetres)

Specimen	GL	Bd	Dd
Sheep astragalus (Sasanian)	292	197	160
Equid metapodial (Sasanian)		397	299

TABLE 7. Mandibular sheep teeth (all measurements are in tenths of millimetres)

	M1W	M2W	M1/2W
Sasanian	76		
Sasanian		82	
Sasanian			73
?Sasanian	72		

TABLE 8. Tooth wear stages for sheep (after Payne 1973; 1987)

	P4	M1	M2	M1/2	M3
Sasanian	8A	9A	4A		
Sasanian		15A			
Sasanian			9A		2A
Sasanian			9A		9G
Sasanian				9A	
?Sasanian	9A				
?Sasanian		11A			

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